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TUNISIA: THE WHEAT DEVELOPMENT PROGRAM

A.I.D. Project Impact Evaluation No. 48

by

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FOREWORD

In October 1979, the Administrator of the Agency for International Development (AID) initiated an Agency-wide ex-post evaluation system focusing on the impact of AID-funded projects. These impact evaluations are concentrated in particular substantive areas as determined by AID's most senior executives. The evaluations are to be performed largely by Agency personnel and are to result in a series of studies which, by virtue of their comparability in scope, will ensure cumulative findings of use to the Agency and the larger development community. This study of the impact of the AID Wheat Development Program in Tunisia was conducted in April 1982 as part of this effort. A final evaluation report will summarize and analyze the results of all the studies in this sector and relate them to program, policy, and design requirements.

ACKNOWLEDGMENTS

The impact evaluation team wishes to acknowledge with gratitude the cooperation and assistance provided by the many members of the Tunisian Government and USAID Mission. This help greatly facilitated this study. Particular thanks is due to Madame Fatma Mamouri L'Arbi of the Bureau for International Cooperation for Agriculture and Mr. Alali Godbane, Chief of the Technical Services Division, Office of Cereals, who were the liaison officials of the Government of Tunisia for the evaluation team and were responsible for arranging interviews, meetings, and field visits.

We were particularly grateful for the opportunity arranged by them to attend, as observers, the technical meeting for reviewing the cereals program, which was organized by the National Agricultural Institute of Tunisia (INAT), the National Agricultural Research Institute of Tunisia (INRAT), the Office of Cereals, and the Ecole Supérieure Agricole du Kef (Superior Agricultural School of Kef) with the participation of representatives of Oregon State University. This was a unique and timely occasion to meet all the Tunisian and foreign experts involved in the cereals program, including some of those who had worked intimately in the Wheat Development Program during its life. Dr. W. L. McCuistan, of the Agriculture Faculty, Oregon State University, who had served on the program with the Ford Foundation in Tunisia, shared generously of his time and provided important background material. Staff members of the Superior Agricultural School were also very helpful.

Mr. Edmund L. Auchter, Program Officer of the USAID Mission, was our official American host, responsible for providing offices, logistics arrangements, support, documentation services, and guidance. His assistance was an invaluable contribution to the achievement of our objective, and is highly appreciated. The staff of the Office of Food and Agriculture was also very helpful, especially Mr. Salah Mahjoub, Agricultural Assistant, and Mr. David Dupras, Agricultural Credit Advisor, in providing important information and documents.

The tremendous task of report typing and obtaining certain background information could not have been done without the splendid, devoted services provided by the American and Tunisian women, and women of other nationalities through a contract with the United States

Government Employees Recreation Association of Tunis, which arranged for secretarial and professional services under the direction of Mrs. Aida S. Dickerherber, Liaison Officer. Mrs. Elke El Abed of the USAID Mission, Mrs. Antoinette El Abed, and Mrs. Ingrid Gray devoted long and arduous overtime hours at night and on weekends to assure the completion of our task on time.

Finally, thanks and appreciation are due to Ms. M. Lorraine Pinkett, Executive Assistant to the USAID Mission Director for her courteous and valuable assistance in supervising and organizing the packing and shipment to Washington of important reference documents.

SUMMARY

The Tunisian Wheat Development Program (Projet Blé) was designed and implemented from 1965 to 1977 by USAID, the Ford and Rockefeller Foundations, the International Maize and Wheat Improvement Center (CIMMYT) in Mexico, and the Government of Tunisia. It was conceived in 1965 at a time when the economic chaos following independence from the French Protectorate prompted the Government of Tunisia to explore every avenue to reverse the decline in agricultural production, particularly of food. Development of Tunisian institutions and training of Tunisian staff were priority goals to fill the gap created by the exodus of the French civil servants and other European farmers and entrepreneurs in 1964. The ultimate goal of the Government was and remains "self-sufficiency in food production."

The purpose of the Program was to introduce and adapt to the Tunisian environment and climate the new semi-dwarf high-yielding wheat varieties that had been developed at CIMMYT in Mexico. The other important purpose of the program was to train Tunisians in agricultural research and extension methods as a means of developing institutional capabilities for Tunisia to carry out research and extension activities alone.

The impact of the Program has been slow but positive. Much of the impact is being felt now, some five years after the Program was phased out and 17 years after its conception. If one single factor had to be identified as the program's most important contribution, it would be the development of the program for advanced degree training, particularly to the Ph.D. level. The research capability developed by this advanced training has become most effective in the past three years. The impact is being demonstrated in research results; in an effective extension program; in improvements in institutional capabilities in research, extension, and education; and in farmers' increased acceptance of new varieties and improved technology, resulting in increased yields and production.

Training has enabled Tunisians to successfully continue research and extension activities without assistance after the program was phased out. Nineteen Tunisians were trained in the United States to the level of M.S. and Ph.D. degrees in agricultural sciences. This was supplemented by practical training of 55 other

Tunisians at CIMMYT in Mexico, in Australia, and in Tunisia. Of the 19 who received advanced training, 13 are working directly or indirectly in the cereals program in Tunisia; 11 of these are directly involved. Of the 19 Tunisians, one is continuing advanced studies in the United States and five are working abroad with international or other organizations. Four of the Tunisians who received Ph.D. degrees are involved in research at the National Agricultural Research Institute of Tunisia (INRAT) while teaching at the National Agricultural Institute of Tunisia (INAT, the national agricultural university). Two Tunisians trained to the M.S. level are participating in the research program at INRAT.

During the life of the Program, five new bread wheat and five new durum wheat varieties were developed and introduced to farmers with varying degrees of success. After the program was terminated in 1977, Tunisians trained under the program continued to develop varieties with characteristics that improved on those developed earlier. In 1980 and 1981, two improved varieties of bread wheat and two improved varieties of durum wheat were developed and put into use. Some of these later varieties were more resistant to diseases and drought than earlier varieties, and consequently were more acceptable to farmers.

An extension and farm demonstration system and program were developed in the beginning of the Wheat Development Program to work closely with the research activities to extend results to farmers and to feed back problems to research scientists. The Technical Division, established in the Office of Cereals, successfully carried out its functions during the life of the program. It is now staffed with trained Tunisians and is still operating a successful program.

As a result of the Program, Tunisia's cereal production (wheat and barley) was greater during the 11-year period 1971 through 1981 by 5.302 million metric tons than during the previous 11-year period. Despite population growth, annual per capita production of cereals increased from 104 kilograms in 1970 to 160 kilograms in 1980, using average annual production figures for the two periods and the population levels of 1970 and 1980, respectively. Furthermore, the increased production was achieved on an area of land less (by over 200,000 hectares in each year, 1980 and 1981) than in the previous four years. The increased production of cereals saved the Government of Tunisia the foreign exchange

costs of annually importing 299,000 metric tons of durum wheat, 77,000 metric tons of bread wheat, and 106,000 metric tons of barley that would have been required otherwise during each year 1971 through 1981. The value of this amount of annual imports at 1981 prices would have been \$125,944,000 (cost, insurance, and freight in Rotterdam, imported from the United States). This was made possible at a total cost to the United States Government, Rockefeller and Ford Foundations, and CIMMYT of less than \$3.5 million in technical assistance.

The Program has resulted in other benefits to Tunisia. It contributed to increased per capita consumption of cereals, mostly in the form of increased use of commercial bread and noodles. While no national data were available to confirm the fact, there was evidence that farmers' income had improved and that subsistence farmers had been integrated into the money economy. Cereal farming had become mechanized and farm families were purchasing prepared foods such as commercial noodles and bread.

The positive impact was not without some negative effects. Rural migration of men had led to a change in the role of rural women, with an increase in their participation in farming and rural industries, and a decrease in their role in home preparation of food. While this may be viewed as a positive gain for women, it has had one negative result. Increased use of purchased, prepared foods (principally noodles and bread) instead of home-prepared food has decreased the nutritional levels of farm family daily diets.

Not all the institutional goals have been achieved. Integration of research and extension has not been acted on. The planners had sought flexibility in management, financing, decision-making, and action by establishing the Program under the parastatal, semi-autonomous Office of Cereals, a commercial organization concerned with the purchase and sale of cereals. This office, which is outside the Agricultural Services of the Ministry of Agriculture, was not impeded by the bureaucratic constraints of other agencies. At the same time, it did not play a role in providing technology to farmers. During the life of the Program, activities were integrated through personal cooperation of scientists who cut across institutional lines. This system continues today.

Despite these weaknesses, the institutions in research, education, and extension have developed basic

capabilities, resulting directly and indirectly from the Program, which permit them to continue successful activities. However, the goal of self-sufficiency in food production has not been achieved. This goal is illusory and has tended to overshadow the progress that has been made, as continued growth of population and increased per capita consumption of cereals have widened the food gap, requiring increases in imports. Tunisia's overall goals of using its resources to comparative advantage, and of producing higher valued crops on the better land (under irrigation where feasible) for export and to supply the thriving hotel-tourist industry are both aimed at achieving a balance in international trade of agricultural products, which makes good economic sense. Achievements in cereal production are due not only to the scientific progress achieved under this Program, but also to improvements in institutions, economic conditions, and policies in the agricultural sector.

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PROJECT DATA SHEET

1. Title: Accelerated Cereals Production
2. Project Number: 665-55-130-205.1
3. Life of Project: Began FY 1965--Ended FY 1976
4. Project Funding: USAID and Ford Foundation

AID Contribution in \$1,000

Personnel	754
Participants	472
Commodities	298
Other Costs	29
Total	<u>1,553</u>
USAID-Owned Local Currency	699
USAID Program Loan H-033 (wheat seed imported from Mexico and other countries)	162

Ford Foundation Contribution in \$1,000

Technical Services and Training	<u>550</u>
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CIMMYT Contract in \$1,000
(AID/afr 573)

Participant Training	
Personnel	
Technical Services	
Commodities	<u>386</u>

TOTAL DOLLAR COSTS	2,651
TOTAL LOCAL CURRENCY (U.S. dollar equivalent)	<u>699</u>
TOTAL AID, CIMMYT, AND FORD FOUNDATION	\$3,350

Government of Tunisia in \$1,000

Trust Fund (U.S. dollar equivalent)	422
Budget Contribution (U.S. dollar equivalent)	<u>1,298</u>
Total Government of Tunisia	<u>1,740</u>

GRAND TOTAL	\$5,070
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Source: Non-Capital Project Paper, Revision dated
November 13, 1970, and USAID Controller's
Records, Accelerated Cereals Production Project.

5. Responsible Mission Directors and Project Officers during life of the Program:

USAID Mission-Tunisia

USAID Mission Directors responsible (1966-1977) were Stuart Baron, Sumner Gerard, Ulmont James, and Herman Davis.

USAID Mission Project Officers responsible (1966-1972) were Samuel Litzenberger, Gaylord Walker, and Buford Grigsby.

6. Other Evaluations Done to Date:

There was one previous evaluation of the Program by a USAID organized team. This was by H.P.H. Johnson, S.C. Litzenberger, and F.H. McNeal in 1972. The team's report was issued under the subject, North African Cereals Improvement Review Team, USAID, Tunis, March-April 1972.

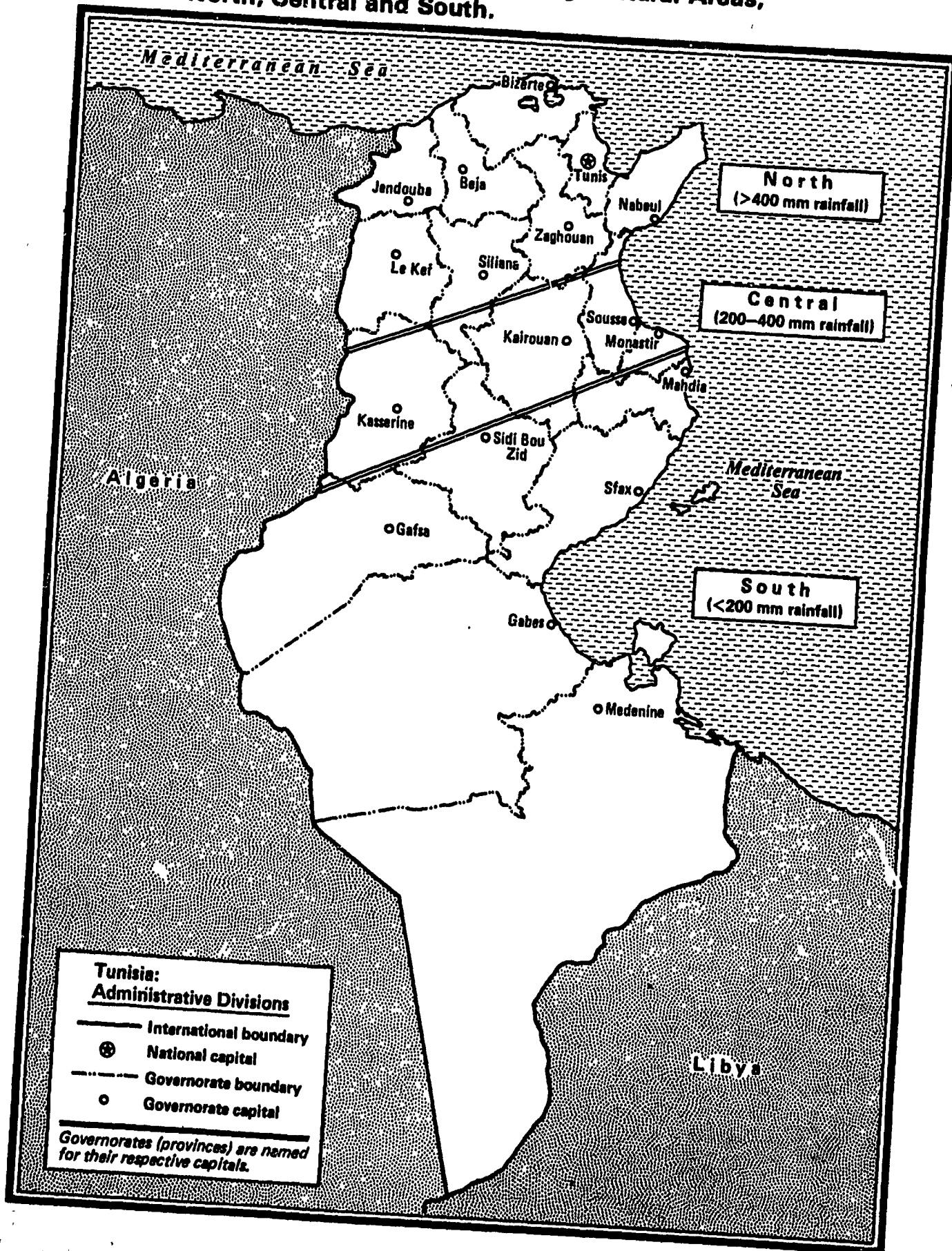
CIMMYT published annual "Progress Reports" in 1973-74, 1974-75, 1975-76, and 1977. However, these were reports done by CIMMYT team members involved in implementation of the project and only reported on the progress toward achievement of goals.

GLOSSARY OF ABBREVIATIONS

ATT	-Agricultural Technology Transfer Project
ACPP	-Accelerated Cereals Production Project
APMANE	-Assistance aux Petits et Moyens Agriculteurs de Nord-Est (Assistance to Small- and Medium-Size Farmers of the Northeast)
BIFAD	-Board for International Food and Agricultural Development
BNT	-Banque Nationale de Tunisie (National Bank of Tunisia)
CCSPS	-Cooperative Centrale des Semences et Plantes Selectionnées (Central Cooperative for Seed and Selected Plants)
CIMMYT	-Center for Maize and Wheat Improvement, Mexico
CNEA	-Centre National des Etudes Agricoles (National Center for Agricultural Studies)
CLC	-Comite Local de Credit (Local Credit Committee)
COSEM	-Cooperative des Semences (Cooperative for Seed)
CRC	-Comite Regional de Credit (Regional Credit Committee)
CRDA	-Commissaire (ou Commissariat) Regional de Developpement Agricole (Commissioner for Regional Agriculture Development)
CTV	-Cellule Technique de Vulgarisation (Technical Unit for Extension)
FOSDA	-Fonds Speciaux pour le Developpement Agricole (Special Agricultural Development Fund)
EEC	-European Economic Community
D/PV	-Direction de la Production Vegetale (Bureau for Plant Production)
FAO	-Food and Agriculture Organization
FY	-Fiscal Year
GOT	-Gouvernement de Tunisie (Government of Tunisia)
HYV	-High-Yielding Variety
INAT	-Institut National Agronomique de Tunisie (National Agricultural Institute of Tunisia)
INN	-Institut National de Nutrition (National Institute of Nutrition)
INRAT	-Institut National de Recherche Agronomique de Tunisie (National Agricultural Research Institute of Tunisia)
OC	-Office des Cereales (Office of Cereals)
OMVVM	-Office de la Mise en Valeur de la Vallée de Medjerda (Office for the Development of the Medjerda Valley)
PROAG	-Project Agreement

OTD	-Office des Terres Dominiales (Office of Land Domain)
PAR	-Project Appraisal Report
OV	-Ordinary Varieties
PROP	-Project Paper
SCMA	-Societe de Caution Mutuelle Agricole (Mutual Agricultural Security Society)
SONAM	-Societe Nationale de Motoculture (National Society for Mechanized Farming)
TD -	Tunisian Dinar; in April 1982 the exchange rate was U.S. \$1= TD 0.5561. The rate has fluctuated around TD 0.500 for U.S. \$1 in the past 10 years.
UCP	-Unite Cooperative de Production (Cooperative Production Unit)
UNA	-Union Nationale des Agriculteurs (National Farmers Union)

**Tunisia: Administrative Divisions, and Agricultural Areas;
North, Central and South.**



I. THE PROJECT SETTING

A. General Background

In 1965, the Government of Tunisia (GOT) and AID/Washington first conceived the idea of introducing and testing in Tunisia the new semi-dwarf varieties of wheat developed in Mexico at the International Research Center for Improvement of Maize and Wheat (CIMMYT). At that time, the Tunisians had had only nine years of experience in establishing a new Government to replace colonial rule under the French Protectorate which had ended in 1956.

In 1964, President Habib Bourguiba broke the independence agreement between Tunisia and France, which had provided for an orderly transfer of control from the French Protectorate to an independent Tunisia. At the same time, he called for eviction from Tunisia of all colon farmers who had been cultivating 850,000 hectares of the best agricultural land in Tunisia and producing almost all of the wheat that was marketed in Tunisia and exported.^{1/} Tunisia was left without managers trained in modern, intensive, mechanized farming methods to operate this land.

The immediate consequence of the loss of the Europeans was a drastic decline in wheat and other agricultural production. Cereal (wheat and barley) production declined from an annual average of 738,000 metric tons during the five-year period ending in 1956 (Table D-3 and Figure D-1) to an annual average of 487,000 metric tons during the five-year period (1965-1969) following eviction of the colons (Table D-4 and Figure D-2), while consumption needs, which were 561,000 metric tons per year in 1966, were increasing with population growth.

Cereals, principally wheat and barley, are the major staple food of the Tunisian population. There are two basic kinds of wheat: durum, or hard wheat, which yields a semolina that is relatively nonglutinous, making it ideal for pastries, spaghetti, and couscous; and soft, or bread wheat, used to make bread by all commercial bakeries. Cereals provided 30 percent of the value added to principal food crops in the agricultural sector during the years 1962 to 1971 (in constant 1966 prices.) Until 1966, durum wheat had accounted for 25 percent of the total value of agricultural exports. Tunisians

^{1/} Harold D. Nelson, Ed., Tunisia--A Country Study, Foreign Area Studies, Washington, D.C.: the American University, 1979.

obtained 57 percent of their daily caloric intake and 70 percent of their protein intake from wheat products.^{2/}

Producing food, particularly wheat, to meet consumption needs was urgent in order to maintain political stability and bring about economic progress. The biggest and most critical task faced by the new Tunisian Government in 1964 was developing a trained staff for administering the Government, and a corps of trained agricultural scientists and technicians to staff institutions and to provide services to the farm population. Farmers had to be trained to manage the former European colon land in capital-intensive agriculture, while the traditional Tunisian farming sector had to be integrated into the modern sector and brought up to date in methods of farming.

The Tunisian Government looked for help to the United States Government, which had signed a Technical Cooperation Agreement in 1957. While the United States agreed to provide food aid, this was viewed as a temporary measure. The Tunisian Government considered it a political mandate to maintain self-sufficiency in food production after independence.

Over time, the Tunisian Government reconciled its difference with the French Government, and in the latter part of the 1960s France resumed a large technical assistance program which had important influences on the Wheat Development Program, both positive and negative. The limited research capacity at the National Agricultural Research Institute of Tunisia (INRAT), even with French assistance, and the weak central system of administration were factors which influenced planners to place the Wheat Development Project outside the normal system of research administration.

At the time, Tunisia had no national agricultural extension system. INRAT did not have direct institutional ties with extension-type activities and lacked a direct relationship with the farm population. Even greater problems were faced by the Program in the policy area in the initial years.

The Neo-Destorian Party which ran the Government was in the process of initiating a national program to imple-

^{2/} William F. Johnson, "Agriculture Sector Paper, Annex to Agricultural Development Loan Paper," Table 17, February 18, 1972.

ment its philosophy of socialism. The approach to development was national planning and control of the economy, utilizing the national structure that had been established under the Protectorate.

Parastatal commodity agencies were established to regulate prices, manage production and distribution, and provide assistance to farmers. One such agency was the Office of Cereals, established in 1962 with over 100 collection and distribution points throughout the rural area. This Office was to assume full responsibility for the Wheat Development Program, or "Projet Ble", as translated in French, a name that identified the Program to the Tunisians throughout the country.^{3/}

The Tunisians retained the national administrative structure that had been established under the Protectorate. This was a highly centralized system with controls at the national level which governed through regional offices, called governorates, to cities, shiekdoms, towns, and villages. To provide services in each sector, ministries were organized at the national level to work through each of the regional offices. Thus, agricultural development was planned by the Ministry of Agriculture and implemented through the governorates. This system continues today.

Cooperatization of land holdings and private businesses had been envisioned by Ahmed Ben Salah, architect of Neo-Destorian socialism, as a means of efficiently managing land resources, marketing the products, and achieving social equity among its participants.^{4/} The program implemented in the early 1960s failed for a number of reasons, but primarily because it destroyed individual initiative and incentives to the producers, cooperative members, and entrepreneurs. Inefficient management and centralized Government controls were other factors. Production declined and agricultural markets dried up. This policy limited the progress of the Wheat Development Program to the state farms until the policy was changed.

These economic consequences and public resistance caused the Government to curtail the cooperative movement

^{3/} Ibid.

^{4/} Harold P. Nelson, op. cit.

in September 1969.^{5/} Since 1969, the Government has followed a mixed policy of "coexistence" of the private, public, and cooperative sectors, under a highly centralized system of national planning with administration through regional offices, called governorates, to local units. However, the disruptive impact of the cooperatization program on private farmers has taken years to overcome and has affected the progress of this Program. Nevertheless, the trend of Government policy toward emphasizing private ownership in the long run has had a very definite positive influence on the outcome of the Wheat Development Program.

B. Agronomic and Environmental Constraints in Wheat Production

The northern part of Tunisia and some of the central plateau are ideally suited to the production of wheat. Here the moist cool air of the coastal Mediterranean Sea, which borders northern Tunisia, combines with the warm air from the Sahara Desert to the south to provide excellent conditions for winter and spring growth and early summer maturing of wheat during normal years. However, in some years the weather conditions result in severe droughts with crop damages or failures.

Wheat, both durum and soft, has always been grown in an area of about 1.5 million hectares on the best soils in the northern valleys and plains of north-central Tunisia. Since growing wheat is normally not as economically rewarding as growing vegetables on irrigated land, nearly all wheat in Tunisia is produced under rain-fed conditions. However, where water is available, some farmers do use supplemental irrigation during prolonged dry periods. Small subsistence farmers in the north and central part of Tunisia survive on durum wheat production which, in the past, they had grown almost exclusively. Barley is grown in the semi-arid region of central and southern Tunisia for both livestock and human consumption. It replaces wheat in the diets of subsistence farmers in these areas.^{6/}

^{5/} M. Yudelman, "Follow-up Report on Tunisian Agriculture," report done for USAID/Tunisia, September 7, 1965.

^{6/} William F. Johnson, op. cit.

Before the Program started, national average annual yields of durum wheat ranged from less than 3 to about 5.5 quintals per hectare (0.55 metric tons) (Table D-5 and Figures D-2 and D-5) depending upon the amount and distribution of annual rainfall. Bread wheat yields had been substantially higher when grown by colon farmers, as they had used a higher level of production technology and farmed the more productive soils. The colons cultivated durum wheat also, primarily for export to French markets, and also cultivated some bread wheat.

Low yields were caused by the characteristics of the varieties of wheat used, climatic factors, soil conditions, and husbandry practices. First and perhaps foremost were the vagaries of the North African climate. Rainfall is highly variable, both in total annual amount and in distribution during the growing season, averaging annually from about 600 millimeters (mm)^{7/} in the North to only 200 mm and below in the dry area in the South (Figure D-4 and Tables D-6 and D-15). Here, barley, which is more resistant to moisture stress and poor soils, is the main cereal crop. Durum also does better in areas of less rainfall than does bread wheat, and is grown further south than bread wheat.

In addition to rainfall variability (Table D-6 and D-15),^{8/} crops are sometimes subjected to damaging hail and wind storms during the latter part of the growing season. Also, frosts can take a heavy toll, reducing plant vigor and yields. Hot winds just before maturity may cause shriveled grain and reduced yields and production.

Fertilizer had been used to a limited extent before the project was started and was confined mostly to former colon lands which were occupied by production cooperatives after the 1964 exodus of colons. Even there, fertilizer use, particularly of nitrogen, was well below the amounts required for optimum cereal production. Use of herbicides for weed control was practically unknown in preproject years. Weeds were then, and still remain, a problem in wheat production, competing with limited soil moisture and plant nutrients and causing reduced yields.

^{7/} 25.4mm = 1 inch. The less productive hilly regions are subject to heavy erosion under cultivation of cereals.

^{8/} Mohamed Ben Senia, "Supply Response of Cereals in Tunisia," abstract of Ph.D. thesis submitted to the Graduate Faculty, Iowa State University, 1981.

When the Program was conceived in 1965, the Government had no national certified seed program. Seed was produced by cooperative seed growers, and the amount was limited. Credit for purchase of inputs was available only to cooperatives and a limited number of private farmers; criteria for bank credit had favored cooperatives and after the end of the cooperative land reform period, the large and medium farmers. Both durum and bread wheat varieties, traditionally used, had become adapted to conditions of low soil fertility, often unfavorable climatic conditions, and less than optimum tillage and seeding practices. These varieties were low yielding even with fertilizer applications.

II. THE PROJECT

At the time of project planning, it was recognized by the Government of Tunisia, CIMMYT, and scientists of the USAID Mission that of paramount importance for improving wheat production was training of Tunisians in agricultural sciences, as well as in management and operations of a national extension and research system. Another basic requirement was to provide equipment, supplies, and general logistics support in an organized manner to assure operational viability. Developing facilities and managerial capacity to operate an effective national seed control and certification service was also necessary.

A. Project Development

In the mid-1960s, AID/Washington became interested in the possibilities of a wheat development program in Tunisia to capitalize on the new technology developed at CIMMYT and spread around the world, heralding the beginning of the "Green Revolution."^{9/}

In April 1966, Dr. Norman Borlaug, Director of the CIMMYT Wheat Project and later a Nobel Prize winner, visited Tunisia and studied the wheat situation. He concluded that environmental conditions in Tunisia were

^{9/} Dana G. Dalrymple, Development and Spread of High-Yielding Varieties of Wheat and Rice in the Less Developed Nations, U.S. Department of Agriculture in cooperation with USAID, Foreign Agriculture Economic Report No. 95, Sixth Edition, September 1978, pp. 10-23.

similar to those in Turkey and in other areas in the Middle East where several semi-dwarf, high-yielding varieties of bread wheat, developed at CIMMYT, had proven superior to local varieties. At Dr. Borlaug's recommendation several hundred varieties of wheat were imported and planted in the fall of 1966, under an agreement by the Tunisian Government, USAID Mission, AID/Washington, and CIMMYT.^{10/} Results were promising. Field tests continued in 1967 and 1968 under a formalized project agreement.

These varieties were planted on private farms throughout the wheat growing area under the supervision of the USAID Food and Agriculture Officer and a team of USAID-funded agricultural scientists. These on-farm plots served as yield-testing sites, and performance demonstrations, initial seed production plots, and training sites for wheat production agents and farmers. The semi-dwarf varieties introduced from CIMMYT were bread wheat, since CIMMYT had never done research on durum wheat, but because of the importance of durum wheat to Tunisia and North Africa, a durum research unit was begun in 1969.

B. Project Description

The Wheat Development Program was implemented under a USAID/Tunisia Mission-funded project called "The Accelerated Cereals Production Project (ACPP)." The initial, primary goal of this project was to make Tunisia self-sufficient in wheat production within five years. The development of the ACPP began in FY 1965, and the program was phased out in FY 1977. The Ford Foundation contributed substantially to the project by providing funds to CIMMYT in support of four wheat specialists working in Tunisia.

In December 1967, CIMMYT, the Ford Foundation, and AID agreed on the major elements of a Regional Wheat Improvement Project for Tunisia and Morocco, which was initiated in June 1968 to complement the ACPP in Tunisia. (The Ford Foundation also funded four CIMMYT specialists in Algeria under a separate agreement.) The Regional Project provided short-term training of Tunisians at CIMMYT's Research Center in Mexico, and

^{10/} W.H. Meinecke, "History and Development of the North African Regional Wheat Program," a paper prepared in AID/Washington, 1968.

short-term special assistance by CIMMYT for studies as required.^{11/}

Genetic material was also provided to Tunisia under the Regional Program. The 1968 project plans of the ACPF envisaged a five-year program in which adaptive research on varieties, fertilizer, seeding requirements, and weed control would be actively pursued. At the same time, the area planted to the high-yielding varieties would be progressively expanded. Simultaneously, a training program would prepare Tunisians to assume responsibility for the managerial and technical aspects of the program at the end of the project.

C. Project Activities

Technical assistance totaling 31 person-years of full-time technical services, plus manpower for a number of special studies, was provided during the life of the project by CIMMYT and the Ford and Rockefeller Foundations. In addition, USAID funded two long-term agronomists and one irrigation engineer under a Participating Agency Support Agreement with the U.S. Department of Agriculture. The USAID Food and Agriculture Officer was the counterpart of the Tunisian Director of the Wheat Project (Projet Blé) and the Coordinator of the Regional Wheat Improvement Project in North Africa.

Using local currency derived from U.S. loans and the PL 480 Program, the USAID Mission financed the purchase of imported seed and farm and laboratory machinery and equipment, as well as the construction of an office building and other facilities.

D. Project Goals

At the time of initial project planning AID had not yet instituted the rigorous and logical description of the project expressed in a "logical framework" format. This requirement came later; in 1972, the original expressions of goals, objectives, and targets were modified to fit these requirements.

^{11/} CIMMYT Progress Report, "Wheat Research and Production Programs, North Africa, Report of Activities During the Period: September 1969-September 1971."

The initial goal of the ACPD was to increase production to the point of self-sufficiency by 1972. The Project Appraisal Report, dated August 18, 1969, states, "The major goal of the program was to make Tunisia free of imports by 1972 through the introduction of new Mexican wheats and the continued support of a package program, i.e., a combination of key production factors properly integrated with agricultural research." One year later, on November 13, 1970, the revised Non-Capital Project Paper seemed to downplay self-sufficiency as a project goal and emphasized institutional development as a goal for the ACPD.

The issuance of the logical framework document in July 1972 provided a clearer statement of what the project intended to accomplish. In that document "an economically sound level of self-sufficiency in cereals production" was shown as the sector goal to which the project had contributed. The logical framework described the purpose of the project as follows: "To strengthen by 1975 Tunisian institutional capability for developing and implementing the adoption of improved cereals technology."

While USAID emphasized institution-building as necessary for achieving self-sufficiency in food production, the GOT made no mention of institutional development and continued to include self-sufficiency in cereals as a national goal, as indicated in the project paper revision dated December 30, 1974.

The project had as specific short-term targets the expansion of the area under cultivation and an increase in production and yields for each year, to reach 300,000 hectares by 1972-1973. The targets were met through 1970-1971, reaching 100,000 hectares, but ran into difficulty with weevil-infested seed distributed that year, which caused a decrease in area planted. Only 50 percent of the target for 1972-1973 was achieved. Specific area targets did not appear in AID's plans after the 1972-1973 target.

The logical framework exercise further elaborated on the goal with a statement of "Conditions Expected at End of Project," including an increase in average annual production of bread and durum wheat to 875,000 metric tons per year, and a self-sustaining, nationally staffed, GOT-funded cereals production program.

Some of these conditions had been met by the time of this evaluation (1982), and some had not.

1. The production goal had been exceeded in total cereals, but was of a different mix than had been planned (greater production of durum wheat and barley, but less of bread wheat).
2. A self-sustaining cereal production program, staffed and operated by Tunisians and funded by the Government of Tunisia was in place. However, not all the components of the goal had been met. Applied research and extension service programs were being conducted successfully, but these services were not formally integrated under one service as was implicit in the goals of the project. Coordination among individuals, started under the project, was continuing.

A national seed multiplication and control service under Government control at INRAT had been established. However, seed production by seed producers was not meeting the increased farmer demand for seed of improved varieties.

Research results were spectacular in terms of new, improved, high-yielding varieties which overcame many of the disease- and drought-sensitivity problems of varieties developed earlier in the project, and were far superior to traditional varieties in yields.^{12/} Total production and yields per hectare had been increased dramatically for durum, bread wheat, and barley (see Figures D-1 and D-2).

The extension service successfully introduced improved varieties and provided training to farmers; increasing percentages of farmers were adopting these improved varieties each year. In the past, the Government had led the farmers. By 1982 the demand among farmers for new variety seeds, fertilizer, and herbicides was exceeding the supply, putting the burden on the Government for further production increases by improving the supply side.

12/ S. Gafsi and T. Roe "Adoption of Unlike High-Yielding Wheat Varieties in Tunisia," reprinted for private circulation by the University of Chicago from Economic Development and Cultural Change, Vol. 28, No. 1, October 1979.

E. Project Organization and Administration

1. The Initial Period

A semi-autonomous unit for cereal improvement in the Extension Division of the Bureau of Plant Production, Ministry of Agriculture, independent of INRAT, was formally organized in 1968. This was done to give the program the administrative flexibility in financing and decision-making that was felt to be needed.

Although funding and technical assistance came from several different sources, the Program operated as a single coordinated project under the authority of the Tunisian coordinator who had been delegated authority to make expenditures from a specific account, with the cosignature of the U.S. Project Director. This type of financial management for a project, new to Tunisia, assured uninterrupted logistic support, an important element in the success of the project.

In January 1969, the Tunisian staff included the coordinator, the technical director, 6 agronomists, 8 technical assistants, and 48 nonprofessionals. By 1972, this staff had been expanded to include 19 professionals with B.S. degrees, 29 technical assistants, and 48 nonprofessionals. The initial CIMMYT/USAID staff consisted of the project coordinator, who was a plant geneticist, three production agronomists, one fertilizer agronomist, and one irrigation engineer.

In January 1972, the GOT shifted responsibility for the project from the Bureau of Agricultural Production to the Office of Cereals where it remained until the project was terminated. This change was made to give the Program additional administrative and budgetary flexibility, and to ally the Program with the input-supply system offered by the Office of Cereals. INRAT provided breeding nurseries and cooperated on breeding work.

2. The Office of Cereals and Projet Ble'

a. Organization of the Program

The project plan called for an integrated organization within the Office of Cereals. There the Technical Division was established and had responsibility for experimental and production programs for the Wheat Development Program, as well as for barley and pulse crops. The division chief, who reports to the Director,

has been with the Program since it started. He was trained under the Program at Oregon State University, where he received an M.S. degree. He also received on-the-job training from the U.S. project chief. (See Table D-10a for the composition of position specializations in the Technical Division.)

The aim of the advanced degree training component of the Program was to train a cadre of competent specialists in several disciplines who would then work as a team to continue the development and extension of new technology to farmers. Only the chief of the division and one other U.S.-trained agronomist in the division have an M.S. or equivalent degree. The section chiefs all have B.S. degrees or two years of college training.

INRAT has continued its cooperative role in genetic research, using two trained Tunisians detailed from the Office of Cereals. This practice has postponed resolution of the problem of clarifying and integrating research responsibilities.

b. Extension Program

In spite of the shortage of personnel and the limited formal training of staff, the Technical Division has successfully carried out intensive cereal production campaigns. For example, in 1979-1980, the staff carried out yield test demonstrations on six durum varieties and five bread wheat varieties at 12 different locations, and on six barley varieties at five locations. Weed control tests were carried out with four different herbicides at four locations, and test demonstrations on wheat were conducted using up to 16 herbicides at nine locations. During the 1979-1980 campaign, the staff spent 59 days in the field demonstrating fertilizer and herbicide use, seedbed preparation, seeding methods, and use of Medicago^{13/} in crop-rotation patterns. These yield demonstrations were attended by an estimated 9,255 farmers in the 1979-1980 season, and were conducted on private farms using farmers' equipment. The Office of Cereals provided all the seeds and materials.

^{13/} A forage legume native to North Africa and reintroduced from Australia in the CYMMYT activities of the projects around 1971-1972.

c. Fertilizer Use

Table D-7 gives the fertilizer recommendations developed by the project and in use in 1973/1974; they differ little from current recommended uses (Table D-8). This raises a question about the nature of the current recommended uses and whether they reflect research findings or a lack of adequate research. The project lost one participant who had specialized in soils, leaving a gap in this discipline.

Use of nitrogen fertilizer on wheat has increased by at least four times since 1968 (Table D-12). A demand for fertilizer, certified seeds, and herbicides has been created among the farm population that is not being met (Tables D-12 and D-13). Agricultural inputs (fertilizer, herbicides, etc.) are not being imported in sufficient amounts by the Government, and sufficient quantities of the new high-yielding seed varieties are not being produced in Tunisia to meet farmers' demand. This shortage is a major constraint to additional increases in production of cereals.

d. Crop Rotation

Applied research to develop the technology for inclusion of selected species of Medicago in a wheat-forage-legume rotation to replace weed fallow is yet to be widely accepted by farmers. The research work has been done but acceptance by farmers has been limited. In 1980-1981 only 3,628 hectares had been planted, representing a decrease in Medicago area from a high of 5,105 hectares in 1976-1977, far short of the goal. One reason is that the system is more complicated than the simple wheat-weed fallow system traditionally used; second, few farmers are able to resist letting their livestock graze during the critical seed development period; and finally, plows used in Tunisia cannot be set shallow enough for the Medicago seed, which is often too deeply buried to germinate.

e. Research and New Technology

Continued and sustained research activities have been the key to success of the Wheat Program. Development of this Tunisian research capability enabled the Program to continue to make progress after the U.S. assistance was phased out. Tunisian researchers continue to develop new crosses, using varieties developed earlier in Tunisia, semi-dwarf varieties from Italy, and new ones from CIMMYT.

Not all the early varieties did well, but field test results were fed back to researchers who then used the experience in their research work. Drought sensitivity and disease susceptibility of some early varieties (such as Septoria disease in the Silete Cerras variety) were identified, and resistant varieties were bred.

Thirteen new high-yielding, semi-dwarf varieties of wheat were perfected or developed during the life of the project or later by Tunisians (see Table D-9). These varieties have been field tested and released to farmers. The superior ones that were developed during the last three years and a few of the earlier varieties are in use. The improved varieties developed since 1979 are more adaptable to the poorer soils and adverse climate, being more resistant to drought, cold, and disease than varieties developed earlier under the program. They also are superior in yield to traditional varieties. Nevertheless, traditional varieties are still in use, primarily because of shortages of seeds of the improved varieties and of necessary inputs.

While barley did not receive much research attention during the life of the project, Tunisian researchers have now begun to work on this crop, and new varieties with higher yields have been developed and are being used.

F. The Training Program

A major training component at several levels was required to achieve Program objectives. Tunisian technical assistants were given on-the-job training by USAID and CIMMYT technicians, and 23 Tunisians were trained early in the Program at CIMMYT in all aspects of wheat breeding, production, and extension agronomy.

The Program also provided for academic training of agronomists, pathologists, entomologists, economists, and managers for planning and carrying out national and region-specific applied research and production programs (see Table D-14). Of the 19 Tunisians who received graduate degrees, as of April 1982, 13 were working in positions where they were directly or indirectly involved with cereals programs. Five were working in other countries, and one Tunisian was a Ph.D. candidate in the United States.

III. IMPACT OF THE PROGRAM

A. Overall Impact

The Program has had a very positive and beneficial effect on agricultural development and on the economy of Tunisia, although it suffered in the beginning from the adverse influences of the land cooperatization policy, (terminated in 1969), from setbacks caused by bad wheat seeds in the early 1970s, and from sensitivities of early varieties to disease and drought.^{14/}

Tunisian farmers were not only trying out a new variety of wheat; they were moving out of traditional, subsistence farming to modern methods of agriculture, and learning the use of fertilizer, mechanization, improved planting and agronomic practices, weed control, market orientation, use of credit, purchase of inputs, and sale of products. All these factors were recognized as interdependent and necessary for gaining acceptance of the new technology. There were successes and mistakes on the part of the program staff, and Tunisian agricultural institutions and Government policy-makers were also slow to change. They had to be convinced that Tunisian farmers could and would manage the new technology, that credit programs could be viable, and that research would pay off. After 1974, there was modest acceleration in adoption of new varieties and in increases in yields of both durum and bread wheat. However, the greatest gains in adoption of improved varieties, in increased yields, and in production came after 1979.

The single most important benefit of the Program has been the training of Tunisians, particularly the advanced degree training leading to the M.S. and Ph.D degrees in agricultural sciences. Tunisians trained in the Program are now successfully carrying forward the research and extension programs. In fact, the greatest progress in the Wheat Development Program has been made by trained Tunisians since the Program was phased out in FY 1977. They have developed improved varieties of wheat (as well as barley) that are more resistant to drought and disease than varieties developed earlier under the Program and therefore meeting greater farmer acceptance. The young Tunisians are also influencing institutional and policy changes that are favorable to agricultural research, extension, and education, and agricultural development in general.

^{14/} S. Gafsi, and T. Roe, op. cit.

The Program has had favorable impacts in other respects. The method of test demonstration of new varieties on private farms is now established practice and is being used for other crop and livestock programs. The Ministry of Agriculture plans to increase local extension activities for farmers, and to date has assigned an extension agent in 150 of the 500 Mechkiats (an administrative unit, formerly called a Shiekdōm) in Tunisia. Their role is one of coordination of information programs for farmers.

Farmers in general are more sensitized to the advantages of research and new technology as a result of the Program. As one Government official put it, "Before, the Government was pulling the farmers along, but now, the farmers are pulling the Government along."

This increased demand has had a favorable impact on policy-makers in the Tunisian Government in terms of increased awareness of the importance of research, particularly the need for site-specific research. On the other hand, the implications for increased investment in research have created problems both in domestic resource allocation and foreign exchange allocation for increased imports of agricultural fertilizers and other materials. This problem is being addressed under a PL 480 strategy developed by the Government of Tunisia and USAID.

There is greater decentralization of research to regional stations representing different climatic zones; two additional stations have been created for this purpose.

B. Use of New Varieties and Increases in Wheat Yields and Production

The adoption of high-yielding varieties of wheat has been slow but gradually increasing, with the major increases coming after 1979. The area planted in high-yielding durum wheat rose from 17 percent of the total area planted in durum wheat in 1979 to 35 percent in 1981. The area planted in high-yielding varieties of bread wheat rose from 43 percent to 68 percent of total area planted in bread wheat from 1977 to 1981 (Table D-11). Harvested areas of the high-yielding varieties reflect some differences. The harvested areas of high-yielding varieties in 1981 were 41 percent of the total harvested area of durum wheat and 72 percent of the total harvested area of bread wheat (Table D-16).

In the principal wheat-producing provinces of the north, higher percentages of the area are planted in the high-yielding varieties developed during the past three years by Tunisians trained under the Wheat Development Program. INRAT 69 (D5835), one of the best of the new durum high-yielding varieties, was developed under the Program. For example, in the Beja Province, the best wheat area of Tunisia, 88 percent of the durum area harvested in 1981 was the improved, high-yielding variety, which accounted for 50 percent of the durum wheat seed passing through the seed certification program.

Both total production and yields of bread and durum wheat have increased significantly as a result of the program, in spite of fluctuations due to weather variability. The most spectacular increases in yields were made in the 1980, 1981, and 1982 crop years (see Tables D-11, D-11a, D-11b, D-16, and D-17, as compared with trends since 1965 and before, Figures D-1 and D-2, and Tables D-4 and D-5). The table below illustrates the magnitude of the increase in production during the 11-year period (1971 through 1981) over the production during the previous 11-year period (1960 through 1970). The production figures were taken from Table D-4 (see also Figures D-1, and D-2, and D-3).

Aggregate Production of Wheat and Barley, 1960-1970
and 1971-1981
(1,000 metric tons)

Crop	1960-1970 (11 Years)	1971-1981 (11 Years)	Total Increase	Average Annual Increase
Durum Wheat	3,615	6,905	3,290	299
Bread Wheat	899	1,746	847	77
Total Wheat	4,514	8,651	4,137	376
Barley	1,373	2,538	1,165	106
Total Cereals	5,887	11,189	5,302	482

The increased production of durum wheat was achieved on an area annually averaging 132,000 hectares more during the second period than the first period (813,000

hectares annual average from 1960 through 1970, and 945,000 hectares annual average from 1971 through 1981). There was little change in area devoted to bread wheat. However, there has been a decline in area planted to durum by 200,000 hectares during the past two years (1980 and 1981) from the annual average in the previous four years (1976 through 1979). Bread wheat area has declined by 40,000 hectares per year during the same period. Despite this decreased area in wheat, production in 1980 and 1981 exceeded that for each of the previous four years (see also Tables D-1, D-3, and D-4, and Figures D-1, D-2, and D-3).

Improvements in barley production did not result from direct efforts of the Program during its life. No agronomic work or varietal improvement research on barley was undertaken under the Program. However, the experience and training of Tunisians under the Wheat Program provided knowledge that was also applied to barley research after the Wheat Development Program was phased out, resulting in increases in barley yields and production on less area during 1980-1981 (see Tables D-1 and D-4 and Figures D-1, D-2 and D-3).

These increases resulted from new technology developed under the Wheat Development Program and other factors which have made possible the use of the technology. The change in agriculture policy with respect to land ownership after the land cooperatization efforts in the 1960s was important. Improvements in the credit program during the decade 1970 to 1980 enabled more farmers to utilize purchased inputs. While pricing was a constraint during much of the decade, the pricing policy was improved recently. A parallel market for durum wheat provided additional incentive, and the Government now announces the new prices for all cereals at planting time instead of harvest time (Table D-2).^{15/} The quadrupling of the application of nitrogen fertilizer to the more fertilizer-responsive improved wheat varieties (Table D-12) and increased use of herbicides for weed control were basic factors responsible for increased yields and production. The change has been necessarily slow in both the farmers' acceptance of change and the Government's ability to develop services.

Crop rotation, which was programmed into research and extension activities under the Wheat Development Program, contributed to overall improvement of production and

^{15/} Mohamed Ben Senia, op. cit.

performance of the farm unit. The system recommended now is wheat-forage-legume rotation. Various grain legumes are being utilized in rotation with cereals. This system is replacing the traditional method of wheat planting followed by a year of weed fallow which was in practice when the Program was started. While Medicago has not spread rapidly because of problems with farm management of the cropping system, other forage crops and edible legumes are making gains in rotational systems.

The rapid increase in use of fertilizer (Table D-13) has created shortages because of limited imports. Higher priorities in foreign exchange allocation have interfered with importation of adequate amounts of fertilizer.^{16/}

C. A Cadre of Trained Tunisian Agriculturists

Training under the project can be grouped into three categories: (a) on-the-job training by project specialists, (b) degree training in U.S. universities, and (c) short-term training to develop specific skills and knowledge.

The degree training of 19 Tunisians has had an important impact on cereals research and extension in Tunisia. Thirteen of the nineteen persons who received graduate degrees are working in positions directly or indirectly related to cereals production, most of them in the Office of Cereals where many of the 55 technicians trained at CIMMYT and on the project are still employed. The Government plans to construct an ammonium nitrate plant (300,000 metric tons by 1985) and to double nitrogen imports under a U.S. AID \$30 million PL 480 strategy.

Four of the thirteen received Ph.D degrees and are teaching or doing cereals research at INRAT, and a fifth is continuing Ph.D studies in the United States. (Present assignments of the returned participants are shown in Tables D-10 and D-14.)

D. An Ongoing National Wheat Research and Extension Program

The Technical Division of the Office of Cereals, although understaffed and inadequately equipped, is successfully carrying out effective extension and test

^{16/} Richard Newberg, "Multi-year Proposal Program Paper--Tunisia PL 480, Title I," USAID/Tunis, 1981.

demonstration programs on private farms. The division is working under the handicap of the lack of a career-development program, which has caused some turnover of personnel. The difference in personnel policies regarding degree recognition has affected personnel assignments at INRAT and INAT.

The project design called for an extension-demonstration service integrated with research and education, but no measures were taken to implement integration. While a division of labor and some degree of specialization have evolved in the functions of the three institutions (INRAT, INAT, and the Office of Cereals), coordination and integration of programs are on an informal and personal basis.

Establishing the functions of field testing and extension for cereals in the semi-autonomous Office of Cereals, independent of the Ministry of Agriculture, was necessary at the time the project was started to provide administrative flexibility. It did prove successful. However, the precedent has worked against formal integration of the three services.

E. A Strengthened Agricultural College

Three Ph.D. scientists trained under this Program and a fourth trained under a related program have considerably strengthened INAT's teaching and research capability in plant sciences. These young Tunisian plant scientists have established research credibility with colleagues in the international plant science community, resulting in a regular exchange of information and plant materials. Also, they have influenced changes in the curriculum whereby teaching is now integrated with research, giving INAT an orientation toward farming and the farm population that did not exist previously. However, INAT does not have a defined, responsible role in national agricultural research programs. INAT initiated a Master's program in agriculture two years ago, independent of ties with French universities, as in the past. The program now is oriented more toward the U.S. experience in agricultural science, teaching, and research. These changes can be indirectly attributed to the Wheat Development Program, although they were not specifically planned by the Program as its goal.

F. A Certified Seed Production Program Established

A new seed-control laboratory has been established and a national seed certification program is operating

which is capable of providing certified seed for up to 20 percent of the total area seeded to cereals. The director of the laboratory was a project participant. The Rockefeller Foundation, through CIMMYT, funded four years of advisory services by a seed agronomist during the life of the project. Assistance was provided by Mississippi State University, under an AID contract financed by the Wheat Program, for developing laws and regulations for production and sale of foundation and certified seed in Tunisia. A rigid inspection service is maintained on all seed production fields. Controls established on foundation and certified seed have enabled Tunisia to be recognized by and become a member of the international organization which monitors such controls. Thus, Tunisia's certified seed program has enabled it to export some small amounts of certified wheat seed to neighboring countries.

G. Economic Impact

The increased annual production of cereals saved the Government of Tunisia annually the foreign exchange costs of importing 299,000 metric tons of durum wheat, 77,000 metric tons of bread wheat, and 106,000 metric tons of barley that would otherwise have been required during each year from 1971 through 1981. The value at 1981 prices of this amount of annual imports would have been \$125,944,000 (cost, insurance, and freight in Rotterdam, imported from the United States).^{17/} This savings was made possible at a total cost to the U.S. Government, the Rockefeller and Ford Foundations, and CIMMYT of less than \$3.5 million in technical assistance.

The value of the 4.137 million metric tons of additional wheat produced from 1971 through 1981 above the production for the previous eleven years (1960 through 1970) would have been \$389,529,529 to date, or \$700,467,461 at constant 1981 farm prices (see Table D-2) and the 1982 exchange rate (U.S. \$1 = T.D. 0.5561).

A comparison of per capita cereal production between the two periods (1970 through 1970 and 1971 through 1981) also shows positive gains. In 1970, the Tunisian population was 5,127,000, and in 1980 it was 6,363,000. Average annual production of wheat in the years 1960 through 1970 was 411,000 metric tons and in the years 1971 through 1981 it was 787,000 metric tons (100,000

^{17/} International Wheat Council, 1981 World Wheat Statistics, 28 Haymarket, London SW1Y4SS.

metric tons short of the logical framework target of 875,000 metric tons per year). For total cereals, average annual production was 535,000 metric tons in the years 1960 through 1970, and 1,017,000 metric tons for the period 1971 through 1981. Per capita production of wheat increased from 80 kilograms in 1970 to 124 kilograms in 1980. For total cereals, the per capita production in 1970 was 104 kilograms, and in 1980 it was 160 kilograms, also reflecting a substantial increase in productivity.^{18/}

Although self-sufficiency in cereals production has not been reached, more Tunisians are eating more cereals. Per capita annual consumption increased from 44 kilograms of bread wheat and 89 kilograms of durum wheat in 1966 to 87 kilograms of bread wheat and 90 kilograms of durum wheat in 1974 based on a 1974-1975 survey. Consumption of cereals was unofficially reported to be higher in 1980. Population growth and increased per capita income (from tourism, petroleum and mineral exports, and improvements in the agricultural sector) have increased demand.

While reaching self-sufficiency has remained an illusory target, the economic benefits of the increased production, which resulted from the Wheat Development Program and a number of other factors, have been many. Some of the principal benefits as well as some of the negative factors are summarized in the following paragraphs.

Additional cereal production has stimulated or created a great number of other economic activities. While it is not possible to quantify these, the increased employment and economic activity generated by the addition to the economy of 482,000 metric tons of cereals in each of the 11 years from 1971 through 1981 were significant. The movement alone of this quantity of a commodity through the process from farm to consumer had a multiplier effect on increased economic activity. Farmers are now using purchased or rented mechanical equipment, and many are using other purchased inputs. Farmers now have more disposable income as shown by their purchases of prepared foods instead of the use of traditional, home-prepared foods.

^{18/} Food and Agricultural Organization, 1980 FAO Production Yearbook, FAO, Rome, Italy.

The policy of low producer prices of wheat and subsidized bread has favored consumers in the industrial sector and urban community, helping keep industrial wages down, thus stimulating industrial development.^{19/} Farm prices of cereals became more favorable after the 1980 price increases, when the prices were announced at the beginning instead of the end of the season as had been done in the past.

The Wheat Development Program contributed to the increased farm mechanization that was necessary for farming with the new technology, a goal of the Government in its agricultural development plans since the early 1960s. Since the 1960s, the Government has imported about 2,000 tractors annually, mostly under U.S. and international development loans. Mechanization was encouraged by Government-subsidized credit and Government-supported machinists societies (Societe Nationale de Moto-culture, or SONAM). The demand for tractor and combine rental has stimulated private entrepreneurs, usually small and medium farmers, to do custom farming or to rent their equipment. The demand for mechanization has been stimulated by the shortage of labor required for use of animals in plowing,^{20/} and the need for quick seed-bed preparation, which is important for any wheat farming, but is particularly important when fertilizer is being used, to capitalize on seasonal moisture and reduce exposure of maturing wheat to mid- and late-summer droughts. At the same time, mechanization has influenced off-farm employment. Forty-seven percent of small size and forty-three percent of medium-size farm operators engage in off-farm activities.^{21/}

^{19/} Terry Roe and David Nygaard, Wheat, Allocative Error and Risk: Northern Tunisia, Bulletin V, Economic Development Center, Department of Economics, Minneapolis, and Department of Agriculture and Applied Economics, University of Minnesota, St. Paul, Minnesota, March 1980. David F. Nygaard, "Risk and Allocative Errors Due to Imperfect Information: The Impact on Wheat Technology in Tunisia," thesis submitted to the Faculty of the Graduate School of the University of Minnesota, December 1979.

^{20/} A 45-horsepower Ferguson tractor can plow a hectare of dry upland in approximately 2 1/2 hours in contrast to 41 hours for 2 bullocks which must also be fed for the entire year (see Appendix B, Footnote 46).

^{21/} Mohamed Ben Senia, op. cit.

Ben Senia's survey showed that 50 percent of all farmers and 45 percent of farmers operating under 20 hectares use tractors. Out of a total 10,190 tractor owners, 1,080 tractors were owned by farmers operating under 10 hectares.^{22/} In another survey, it was found that 80 percent of all seed bed preparation was mechanized.^{23/} The farm implement that has freed the greatest amount of labor is the combine. This is particularly true on small farms where harvesting traditionally was done by hand.

Fragmentation of land holdings has been a constraint to rapid agricultural development and rapid progress of the Wheat Development Program. Fragmentation of holdings is prevalent particularly among small- and medium-size farms. A farm may be divided into as many as six or eight parcels, often separated from each other by distances of several kilometers. This has increased the incidence of land rental by farmers seeking consolidation. In their study, Gafsi and Roe found that large farmers do not dominate the land rental market, but participate in it.^{24/} The total area occupied by large- and medium-farm units (above 50 hectares) in Tunisia has increased while the area occupied by small-farm units (less than 50 hectares) has decreased.

Evidence of increased monetization of the rural sector is found in improved and expanded credit programs among traditional farmers. Ten to twelve years ago when the Wheat Program was started, Government credit programs were unsuccessful in the traditional sector. Often small farmers consumed the seed granted by the Government and sold the fertilizer provided through credit. Now, credit programs are experiencing greater success and the demand for credit is greater than that available.

The increased demand for inputs and the use of rental equipment, requiring cash and credit, provide additional

22/ Ibid.

23/ Salem Gafsi, "Green Revolution: The Tunisian Experience", abridged and published by CIMMYT, Mexico, 1976 (abridged from Gafsi's Ph.D. dissertation at the University of Minnesota).

24/ S. Gafsi and T. Roe, op. cit.

evidence of a trend in increased monetization as well as increased incomes in the traditional farming sector, which were influenced by the Program as well as contributing to its success.

H. Sociological Impact

Positive and negative impacts which have had particular social repercussions on farmers of northern Tunisia but which have also had an impact on the nation as a whole are described below.

1. Positive Impacts

All farmers, young and old, small and large, are now aware of the existence of high-yielding varieties, especially of durum wheat which is the traditionally preferred wheat for food consumption in Tunisia. The high rate of adoption, reflecting a profound change in the farmers' attitudes towards adapting to new cultivation practices and to new tastes in food, is particularly impressive in view of the fact that the average age of farmers is 55.

The Program was instrumental in changing the relationships between farmer and technician, particularly the extension workers, so that more time was spent by extension agents in the field and more contacts were made with farmers.

The Program was also instrumental in creating greater awareness among small farmers of the need for changes in farming practices, bringing in new types of inputs and new techniques. The use of fertilizers has increased so much that the supply in 1981 was insufficient to satisfy demand, and the number of distribution centers too few to cover all rural areas effectively. Female labor, salaried and nonsalaried, has increased dramatically and has become integrated in the farming system of the north. The percentage of women employed in agriculture rose from 8 percent in 1966 to 26 percent in 1975.

2. Negative Impacts

A contradiction exists between production needs and the needs of the many farmers who are not able to keep up with the new technology. Some small farmers have found it necessary to rent or sell their land, often to medium or large farmers; they were then sometimes employed as laborers to work on this same land. This has allowed medium and large farmers to increase their farm sizes, especially on the best arable land.

Increased mechanization of farming has encouraged an already vast rural exodus, increasing unemployment in urban areas, and also creating labor scarcity in rural areas during peak seasonal needs. The number of employed agricultural laborers has declined by 41 percent since 1975. Rural exodus of the young has led to an increase in the average age of farmers (now above 55) actually engaged in farming.

Consumption patterns have changed in favor of greater consumption of French bread and noodle products and decreased consumption of couscous and traditional home-made breads. The use of refined wheats in the former products versus whole wheat use in the latter products has been a factor in nutritional deficiencies. This is due, in part, to the effective integration of women into the agricultural labor force, which has reduced the time they spend in cooking foods and caring for the household.

The goal of increased production of bread wheat has not had the expected impact on the majority of farmers. Instead, high-yielding varieties of durum have been more widely adopted because of palatability criteria, higher prices, and greater drought resistance and yield stability on poorest soils than bread wheats, thus making use of durum wheat less risky than bread wheat, even with the new varieties of both wheats. This impact is reflected in the continued decline in the production of bread wheat after 1972 despite increases in yields, and in the continued rapid rise in area and production of durum wheat (see Figures D-1 and D-2).

IV. CONCLUSIONS

Agricultural research is by nature a slow process. Judging its success or failure can lead to erroneous conclusions if the analysis is done prematurely or with the wrong perspective. For example, if an impact analysis of the Wheat Development Program had been made in 1975, the termination date of the Program (as distinguished from the phaseout of activities, which was in FY 1977), different conclusions would have been made. Some of the technology (i.e., the varieties developed by that date) had not gained sufficient acceptance and suitability to be deemed a success, and the rate of adoption was not nearly as impressive as it is now.

If the success of the Program had been measured by the criteria of the degree of acceptance and adoption of any single variety during the life of the project,

negative conclusions could have been drawn. If judged on the number of people trained, the analysis could have been positive, but there may not have been any measurable impact. The real question, therefore, in the determination of the success or failure of the Program, is whether or not an institutional capability has been developed that can effectively carry on sustained and continuous research and extension programs.

Today, the results provide positive evidence that a basic institutional capability does exist in Tunisia, although thin in number of scientists and disciplines. While institutional problems remain, a basic capacity has been created through the development of trained and dedicated young Tunisian agricultural scientists who can successfully carry on the necessary research and extension programs. Therefore, an important conclusion is that the greatest impact of the Program was made after assistance was terminated, and this impact was made possible primarily by Tunisians who received advanced degree training in agriculture sciences under the Program.

This leads to another conclusion. Government policy-makers, who by tradition are conservative and skeptical of research, need convincing evidence that research investments will pay off. It has taken some 17 years in Tunisia to gain sufficient experience to be able to present a convincing case for research. As one official in the Beja area pointed out to us, "New wheat varieties are now a la mode. They are coming out every two or three years now, and farmers are going to research stations, asking for more information about them, and looking for new developments in technology."

Research results are quantifiable in increased yields, increased production, and value added. Nevertheless, this merits a word of caution. The goal of self-sufficiency still exists in the minds of Tunisian policy-makers, and this has not been attained. Despite gains, the magnitude of progress may be overshadowed by the increased magnitude of consumption needs. Therefore, careful analysis is required, not just for a few years, but for a sufficient timespan to balance effects of erratic weather and other natural biases.

While the impact has been significant, it could have been greater. There is still a large percentage of farmers who have not adopted the new technology. Why? A major reason is that the efforts to "sensitize" the farm population to the value of the new technology was more

successful than policy-makers had anticipated. Two decades of efforts to change the traditional sector had created skepticism about the capability of farmers to change. What was not realized was that farmers can make rational decisions, and when the marginal gain by the increased risk in adopting new technology is favorable enough, they will change. In recent history, the Government was not prepared adequately to respond to the demand that it had created. The extent of the demand by farmers for fertilizer, herbicides, and new seed varieties had not been anticipated, and Government offices, such as the fertilizer import society, the Office of Cereals, and other agencies, had not imported and stocked adequate supplies to meet the demand.

At the same time, "sensitizing" the farm population has not been easy. It has taken years to overcome the effects of the social and economic upheaval of the 1960s and the effects of living under a "Protectorate." Developing confidence and individual incentive among farmers has naturally come slowly. Introduction of a new technology has not been the sole agent of change. Its usefulness and benefits were and are applicable and feasible only after a number of other developmental conditions had been fulfilled. This has involved many economic and social changes, the creation of an infrastructural base, and development of institutional capabilities. Yet, relative to the history of industrial nations, some of these changes have been rapid. The change in the literacy rate, for example, from 16 percent in 1960 to 55 percent in 1980, and the change from animal-drawn plowing to mechanized farming in most of cereal production has taken about 15 years. These changes have had a bearing on the rate of progress in adoption of the Wheat Development Program's new technology and on its impact.

A successful national agricultural research program in Tunisia at the time the Program was started could not have been achieved without international scientific cooperation. Sharing of the scientific knowledge and material of the international scientific community was an essential ingredient in the scope of the Wheat Development Program in Tunisia. The Program was dependent on scientific consultation; advice; technical assistance; and training and/or experience of international agricultural scientists at CIMMYT, U.S. universities, the Ford and Rockefeller Foundations, and the U.S. Department of Agriculture.

Another conclusion relates again to the importance of research. Tunisia is now blessed with two important depletable natural resources, oil and phosphate rock, which have helped elevate the economy of the country to the middle-income level in terms of per capita annual income (\$1,185 per person per year in 1980).^{25/} It is understood that in another 10 years the petroleum supply will decrease and domestic consumption of oil will increase to make Tunisia a net importer of oil. What better use could Tunisia make now of some of its oil wealth than increasing investment in research to include such things as alternate energy sources for agriculture, including animal power and biological sources of nitrogen?

A final conclusion is that there were unanticipated sociological changes, both positive and negative, which were influenced to some extent, either directly or indirectly, by the Wheat Development Program.

The change in food consumption patterns of farm families increased the availability of farm women for farm and other employment and is said to have had an adverse effect on the quality of farm family diets. The positive effect is that women are playing a more important economic role on the farm and in off-farm employment. Rural migration of men has increased unemployment in urban areas, but the remittances of those who are employed abroad to their farm families has added to farm incomes.

V. LESSONS LEARNED

A. The Goal of Cereal Self-Sufficiency Is Illusory and Can Overshadow Progress Made

The goal of self-sufficiency in cereal production in Tunisia is illusory and has tended to overshadow the progress that has been made. Population growth and increased per capita income have increased food consumption, widening the food gap despite significant increases in total production, yields per hectare, and production per capita. Maximizing the comparative advantage in agricultural production by growing higher valued crops on better lands under irrigation to supply the hotel-tourist industry and export trade, and to achieve a balance in trade of agricultural products make good economic sense.

^{25/} The World Bank, World Development Report, 1981.

B. Graduate-Level Training Was a Key Component Contributing to Development of Institutional Capability and Long-Term Success of the Program

The graduate-level training program leading to the M.S. and the Ph.D. degrees was the key component to long-term success of the Wheat Development Program. Although still thin in numbers and disciplines, the agriculturists who have been trained have provided the basic institutional capability needed for continuing and sustaining the programs in agricultural research and extension that were started by the technical assistance program. However, U.S. graduate-level training of highly capable students has equipped them with skills, knowledge, and motivation that are much in demand not only in Tunisia, but internationally. So it is not surprising that participants who have completed their training abroad are sometimes attracted to jobs outside Tunisia offering higher salaries or more attractive perquisites than assignments in jobs in Tunisia can provide. It would be wise in future projects to provide for the training of a greater number of persons than needed for a project, and to encourage the host government to standardize rewards for participants among agencies of the Government and institutions of the country.

C. Successful Adoption of the New Wheat Technology Has Been Dependent on Overcoming Socioeconomic Constraints Policy Issues, and Institutional Problems Associated With Economic Development

Basically, the factors which have constrained the Program relate to the country's background, state of development, recent independence, and the social and economic experimentation that followed the Government's efforts to develop the country's agriculture. Essentially, the wheat technology that is being introduced is dependent on capital-intensive farming, utilizing mechanical equipment, fertilizer, other agricultural chemicals, and selected seeds. These all require credit and a rural infrastructure for marketing and distribution of inputs. These factors had existed for the European colon farmers in the modern sector, but had to be introduced to the majority of Tunisians after independence.

The Wheat Development Program could move only as fast as these constraints were removed, favorable policies issued, institutions developed, and marketing and supply infrastructure put into place and supplied with inputs. Farmers have responded to extension programs, and have

adopted the new technology to the extent permitted by the availability of inputs, which is now a remaining important constraint. Recent improvements in pricing policy have improved incentives.

Also, food consumption patterns, tastes, and preferences of farm families may outweigh apparent economic advantages when a new crop variety is being introduced. These factors need to be identified and considered in planning research and extension programs. Tunisian farm families have a strong preference for traditional durum varieties over new bread and durum wheat varieties for home consumption. Many farmers adopting new high-yielding varieties of durum continue to grow small amounts of the traditional varieties for home consumption.

D. Coordination by National Research Scientists With Research Scientists in the International Research Community Is Essential To Keep up to Date

International coordination is essential if a national agricultural research program is to take advantage of external scientific developments. This cooperation can accelerate domestic research and avoid costly and time-consuming mistakes. The international agricultural research centers provide invaluable research services for developing countries.

E. Adaptive Research Programs Must Proceed Cautiously, Taking Into Account Different Environmental and Sociological Factors

Adaptive research programs for the introduction of new technology from a different environment must proceed cautiously and be planned to cover different micro-climates and ecologies in a new country over a sufficient period of time to assure adaptability. Also, the research and extension programs must be designed to accommodate special needs and customs of traditional farmers when changing from traditional to modern practices.

The use of on-farm test demonstrations in different geographic locations to conduct location-specific tests for different ecological zones under private farming conditions and to inform farmers on the new technology proved to be an important approach. The benefits of this method were recognized, adopted, and are still in

effect. As stated, researchers are closer now to the farmers' problems.

F. Strengthening National Institutions in Agricultural Research and Extension Is a Long-Term Effort, Sometimes Requiring New Approaches; But Short-Term Expediencies May Constrain Achievement of Some Long-Term Institutional Goals

Sometimes old methods of doing research and extension may not be the most suitable approach. Change may be necessary or important for accelerating research. It was necessary to introduce new concepts and methods of doing research and extension in the Wheat Development Program in Tunisia. Avoidance of bureaucratic procedures through the creation of semi-autonomous organizations outside the institutions involved in research-education-extension may overcome administrative bottlenecks and accelerate action programs in the short term, as it did in Tunisia, but this does not solve basic institutional constraints inherent in the system. It simply bypasses the bureaucracy and sets a precedent that is difficult to overcome and that may contribute to continued proliferation of such examples in other agencies of government.

Research programs are long term. Even with technology that was proven successful elsewhere, the adaptive process is slow. In Tunisia, 17 years of research were required to firmly establish evidence of possibilities of lasting changes in farm practices.

G. Research Is Important to a Country's Development, and Needs Recognition and Adequate Support by Policy-makers; The Payoff on Investment Can Be Great

Research programs are not always given the financial support they need. The proportion of total budget allocated to research is low in Tunisia (less than 2 percent). Nevertheless, the evidence of payoff more than warrants the investment made, as Tunisia demonstrates. Policy-makers need to be kept informed of such payoffs. This is true of policy-makers in the recipient country as well as policy-makers in donor countries.

H. An Agricultural Economic Analysis Capability in the Country Is Essential to Successful Agricultural Research and Development Programs

An agricultural economic analysis capability, such as exists in the Bureau of Planning, Statistics, and Economic Development in Tunisia, is essential for

successful agricultural research and development programs. Such capability is needed to provide objective measurements of national crop production and yields. This is necessary to inform research scientists and policy-makers of the effectiveness of farmers' adoption and use of innovations developed by research programs. Problems and constraints can be readily identified to guide planners. Furthermore, such analysis can be used to compute the value and benefits to show policy-makers when research investments and policies are paying off!

I. Unanticipated Sociological Changes, Both Positive and Negative, May Result From a Successful Research and Production Program

Palatability of food in the daily diet of farm families, their need for a secure source of food supply, and the risk of losing this source of supply by investing in innovation for unknown benefits are compelling sociological factors which can constrain progress. These factors must be recognized in planning research and extension programs that are aimed at making changes in the production and consumption of major food crops.

Agricultural development can change a subsistence economy to a market-oriented economy with both positive and negative social and economic consequences. However, these are difficult to predict, and difficult to change when they are recognized.

These consequences can include rural migration, particularly of males, which increases rural employment of women, reduces their role in home preparation of food, and results in increased use of purchased, prepared food with a negative effect on the nutritional quality of food in the daily diets of rural people. Rural migration of males may increase unemployment in urban areas and create seasonal shortages in rural areas. At the same time, migration to employment in industrial countries, as in the Tunisian case, can increase family incomes in the rural area and contribute to progress in agricultural development. The impact on the role of women in agriculture and rural industries may be significant, with positive and negative benefits to the social and economic wellbeing of the farm family, as cited.

APPENDIX A
METHODOLOGY

I. GENERAL APPROACH

The first task was to conduct a search and review of the literature on Tunisia. An obvious source, the library, was not adequate because some of the most important recent documents have not reached all libraries, and even some of the older ones never received wide circulation. Therefore, we contacted authorities on the subject at the University of Minnesota, Dr. Malcom Purvis and Dr. Terry Roe, who provided information and reference material.

The University of Minnesota's relationship with Tunisia dates back to the middle of 1960 under an AID contract to assist the Government in developing a Bureau of Planning, Statistics, and Economic Analysis. The University was responsible for training approximately 30 Tunisians to the M.S. degree, and a few to the Ph.D. degree in agricultural economics. This contact led to the discovery of three important and relevant Ph.D. degree theses, several papers, and articles related specifically to the Wheat Development Program. These were obtained and reviewed by the team.

In the meantime, AID project documents and other written material on Tunisia, published and unpublished, were accumulated from various AID/Washington Bureaus. This material was made available to the evaluation team for review and study.

The next step was to track down and establish contact with former project personnel who had worked for the Ford and Rockefeller Foundations and with the International Maize and Wheat Improvement Center (CIMMYT), organizations which had participated with AID in the Wheat Development Program in Tunisia. Former project personnel were located and interviewed.

These included Dr. W. McQuiston, who is now a member of the faculty of Oregon State University. Dr. McQuiston provided CIMMYT reports and records not available in AID. He also informed us of former Tunisian participants who had returned to Tunisia and were in important leadership positions in research and development in the cereals program.

Dr. Sam Litzenberger is another former Project Officer who was contacted. He was the AID Project Officer for the Accelerated Cereals Production Project responsible for developing and implementing the project in 1968.

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Dr. John Doolette, an Australian agriculturist who served with CIMMYT on the Wheat Development Program in Tunisia, was interviewed at the World Bank where he is employed in the European and Mediterranean Division. He provided copies of reports on the Wheat Project.

Enroute to Tunisia, Johnson and Ferguson visited FAO in Rome where persons concerned with Tunisia and those knowledgeable in European-Tunisian agricultural trade were interviewed. Relevant documents were obtained for review.

On arrival in Tunisia, the team reviewed USAID Mission and Government of Tunisia historical and current documents on the project and on Tunisian agriculture and the economy.

While in Tunisia during April 1982, we relied heavily on two important contacts with the Government of Tunisia, Madame Mamouri L'Arbi, Direction Cooperative International De L'Agriculture, Ministere De L'Agriculture, and Mr. Alali Godbane, Chief of the Technical Division, Office of Cereals. Both were former U.S. participant trainees. Mr. Godbane had been trained under and has served continuously with the Wheat Development Project (Projet Ble) since its inception and is still responsible for the project in the Office of Cereals. He was the official liaison official for the team. Madame L'Arbi, who had earned an M.S. degree at the University of Minnesota with the Bureau of Planning, Statistics, and Economic Analysis, was the official contact point for the team with the Ministry of Agriculture.

By invitation, the team attended as observers a one-week workshop in early April on cereals organized by the National Agricultural Institute (Institut National Agronomique de Tunisie, INAT) with the cooperation of the National Agricultural Research Institute (Institut National de Recherche Agronomique de Tunisie, INRAT). This proved to be the most informative and useful part of our study in Tunisia. All the cereals experts in Tunisia were present as were some experts from abroad. Dr. W. McCuiston participated as a member of an Oregon state team for an AID project in Tunisia.

The purpose of the workshop was to review the progress of the Government's cereals program, to discuss problems and constraints, and to formulate plans and measures for coordination of the various offices,

agencies, and institutions involved in the program. Our attendance facilitated contacts with a number of Tunisians working at INAT and INRAT in research, education, and extension in the cereals program. These included several of those trained in the United States under Projet Ble', including two authors of the theses referenced above.

Following the workshop, the team, by invitation, joined the cereals group, which had organized the workshop, on a tour of cereal production areas in northern, central, and southern parts of Tunisia. Inspection trips were made to regional research stations at Beja, Le Kef, and Svietla. Visits were made to a number of private farms, including some which served as demonstration-test farms for the Office of Cereals extension field testing program.

Following this tour, meetings were held in Tunis with officials in the Ministry of Agriculture responsible for agricultural development programs, with public agencies responsible for credit, and with research and education staffs at INRAT and INAT, respectively. We explained our objective to the officials, and solicited their opinions on specific questions that concerned the team.

A final tour was made of three governorates in northern and central Tunisia to visit public offices and other private farms. On this tour, contact was made with the Regional Agricultural Officers of the Governorates and with other officials, including the Governor of Jendouba. Also, visits were made to local offices of one of the small-farmer credit agencies, Assistance Aux Petits et Moyens Agriculteurs du Nord-Est (APMANE), which provided staff members as guides for part of our trip. The last part of our stay in Tunisia was spent drafting the reports.

Each member of the team prepared a report dealing with the topic of their respective discipline: economics, agronomy, and sociology. Prior to the departure, debriefing sessions were held with the USAID Mission and with Madame L'Arbi and Mr. Godbane for the Government, at which the team's principal findings and conclusions were presented.

Upon arrival in Washington in early May 1982, a debriefing session was held with the Evaluation Staff of AID's Bureau for Program and Policy Coordination.

The team leader drafted the final report, embodying the agronomic report of Dr. Ferguson, and including impact findings and lessons learned from the economics report and from the sociological report, each of which are included as appendixes to the main report.

II. METHODOLOGY FOR AGRONOMIC ANALYSIS

With respect to the agronomic, training, and institution building aspects of the project, the approach for appraisal and evaluation of results and impact was rather straightforward. One of the first tasks was to find out from the Mission and the Government of Tunisia (GOT) files how many participants had been trained and where they are now assigned. This was important since building an institutional capability to develop and carry on a wheat improvement program was the stated purpose of the project. We found excellent participant records in Mission files which were easily verified and updated by contacts with officials of Projet Ble and a former participant now on the INAT staff.

The Chief of the Technical Division, (Projet Ble) Office of Cereals, provided information on the organization of the division, including staffing and facilities, and details and statistics on the annual cereals production programs and on-farm demonstrations for which the Technical Division is responsible. This included information on the evolution of fertilizer use since the beginning of the project. Heads of the different sections of the Technical Division provided information on their specific programs, problems, and achievements.

Interviews with the Regional Agricultural Officers in Beja and Jendouba provided detailed information on the agricultural programs in the respective areas, including use of high-yielding crop varieties (HYV) and the problem of provision of the production inputs required to obtain full advantage of the yield potential of these varieties. On-farm visits in the Beja, Jendouba, and El Fahs regions gave the team impressions of how farmers feel about the HYVs and especially about access to markets and inputs, or lack thereof. Attendance at the workshop, referenced above, provided information on progress in the development of new HYVs and their impact on cereals production, and enabled the team to obtain firsthand information on varieties which were selected during and after the project and have been released for multiplication.

The most valuable source of data on the impact of the project on wheat production in Tunisia was the Division for Planning, Statistics, and Economic Analysis of the Ministry of Agriculture. That division is the official agricultural statistics-gathering agency of the GOT, and has made annual objective yield, production, and area surveys of cereals in Tunisia in each of the past several years. These records show separately the HYVs and traditional varieties of durum and bread wheat with respect to area seeded, area harvested, yields, and production by region. This enabled the team to compare yields and production of wheat in preproject years with production during and following termination of the project.

The Director of INAT, in an interview, gave his views on the impact that the project has had on the Institute as a result of the assignment of four returned Ph.D.-level participants, trained under the Program, to the Plant Science Department. Interviews with four of the INAT faculty provided the team with information on research in the socioeconomic area relating to cereals, on the specific courses taught by the returned participants, and their research in cereal breeding and production.

During a visit to the Seed Control Laboratory, established by the Project, the Director described the purpose and function of the laboratory, and the extent to which the seed certification program is able to meet the requirements of the country.

III. METHODOLOGY FOR SOCIOLOGICAL ANALYSIS

Tunisia, unlike the rest of Africa, has the great advantage of having a generally homogeneous ethnic profile. Very little data, however, exist on northern Tunisia, making difficult a detailed understanding of the sociological environment of that region. However, census, 1968 and 1975 consumption surveys, and agricultural surveys data exist and were invaluable for our analysis. Although the Wheat Development Program concerned northern Tunisia, its impact was far-reaching in the nation as a whole. It was, therefore, important for us to relate the northern region to the country as a whole.

The sociological analysis is divided into three sections, before, during, and after the project, as a means of evaluating the process of change that took place

between 1965 and 1982, but also to highlight the sociological situation which confronted the project at the start. The analysis centered on three topics: land tenure and agricultural labor and consumption patterns.

A wealth of information existed in the data available, allowing comparisons between the three different periods dealt with. Our fieldtrips, too short to allow us to gather primary data, served essentially to confirm the findings of the data studied.

The choice of villages visited was based essentially on climatic differences, an important variable in wheat production. Within the villages, small, medium, and large farms were visited to allow comparison of their respective suitabilities to the new varieties used.

Numerous interviews were held in Washington with nutrition specialists on Tunisia at the World Bank and the Food and Drug Administration, and in Tunis with officials and researchers of the National Institute of Nutrition, the Office of Cereals, the Statistical Division of the Ministry of Agriculture, the National Institute of Statistics, and researchers in economics and sociology at INAT.

APPENDIX B
INSTITUTIONAL, POLICY, AND ECONOMIC INFLUENCES
OF THE WHEAT DEVELOPMENT PROGRAM IN TUNISIA
IMPACT EVALUATION

by

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Washington, D.C.

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I. BACKGROUND

A major factor affecting the outcome of the Wheat Development Program (Projet Ble' as it is called in French) was the transformation of Tunisia from a colony under the French Protectorate to an independent nation. The politics of this transformation and the lack of developed institutions and trained personnel influenced the achievements of this project as well as the course of agricultural development. Other factors were the nature of Tunisia's agriculture, the climatic environment, Government policies, and socioeconomic and institutional problems.

Wheat and barley are the cereals produced in Tunisia. These crops are of paramount economic and political importance to the country, as they had been to the French. Cereals were and remain the major staple food of the population. There are two basic kinds of wheat: durum and soft, or bread, wheat. Durum, a hard wheat, yields a semolina that is relatively nonglutinous, making it ideal for pastries, spaghetti, and couscous. Use of durum semolina for making bread is confined to rural families and that usage is decreasing. The soft wheat is used for bread in all commercial bakeries. Tunisian durum has a higher protein content than bread wheat.

The French had produced durum wheat for export to the pastry industry in France, while importing soft or bread wheat, which was also grown in Tunisia in smaller quantities and used to make bread for the urban population.

Cereals provided 30 percent of the value added to principal crops in the agricultural sector from 1962-1971 (in constant 1966 prices). Until 1966, durum wheat accounted for 25 percent of the total value of agriculture exports. Wheat, both durum and soft, has always been grown on an area, varying slightly from year to year, of about 1.5 million hectares on the better soils in the northern and north-central part of Tunisia, where rainfall is normally sufficient to support these crops. Small subsistence farmers survive on durum wheat production in the northern and central parts of Tunisia, and on barley grown in the semi-arid region of central and southern Tunisia, both for livestock and human consumption. Barley replaces wheat in the diets of subsistence farmers in these areas.^{1/} In 1966, a household survey showed per capita consumption of 44 kilograms per year of soft wheat (bread wheat) and 89 kilograms of hard wheat for noodles, pastry, couscous, and, in some cases, bread in the rural areas.^{2/}

II. SETTING IN 1965

In 1965 when the idea was first conceived in Tunisia of introducing and testing the new semi-dwarf, high-yielding varieties of wheat developed in Mexico at the International Research Center for Maize and Wheat Improvement (CIMMYT),^{3/} the Tunisians had only nine years of experience in establishing a new Government to replace colonial rule under the French Protectorate. Tunisia's independence in 1956 brought an end both to colonialism and to the Tunisian hereditary monarchy of the "Bey" dynasty, which the French had utilized in civil administration since the beginning of the Protectorate in 1881.^{4/} This system had been effective in civil control, but no national extension system had ever been developed to serve the Tunisian traditional agricultural sector. A small research station in Tunis served the European colon (commercial farmers).

It had taken the French from 1881 to the 1920s to discover that the wheat technology developed in France was not transferable to the colony of Tunisia. They established a cereal research station at Tunis in the 1920s to develop wheat varieties suitable for the country. In 1933, a French genetic scientist developed a suitable bread wheat variety, Florence Aurora, and later the durum wheats, Chile and Roussi. Still later, Mahmoudi and D-117 durum wheat varieties were developed. These varieties and the technology of capital-intensive, mechanized wheat farming were introduced through the research station and utilized by colon farmers until independence. With the exception of a few large Tunisian farms, the farming practiced by Tunisian farmers followed traditional practices, and was labor and animal intensive.^{5/}

The Tunisians adopted the national administrative structure established under the Protectorate. This was a highly centralized system with controls at the national level which governed through regional offices, called governorates, to cities, shiekdoms, towns, and villages. The new Tunisian Government appointed party members to head and staff these units. Ministries were organized at the national level to provide services in each sector, working through each of the governorates. Thus, agricultural development was planned by the Ministry of Agriculture and implemented through the governorates. This system continues today with some modification.

The biggest and most critical task faced by the new Tunisian Government at independence was developing staff

to administer the Government and a cadre of trained agricultural technicians to provide services to the farm population. Farmers had to be trained to manage the former European colon farms in capital-intensive agriculture, while the traditional Tunisian farming sector had to be integrated with the modern sector and brought up to date in methods of farming.

Producing food, particularly wheat, to meet consumption needs, was urgent in order to maintain political stability and bring about economic progress. As a stopgap measure, France agreed to leave 3,000 French officials in Tunisia to assist in the transition. France also sent more nationals to provide technical assistance and to staff schools and medical facilities.6/

The United States signed an Economic Cooperation Agreement with the Republic of Tunisia on March 26, 1957. Training of personnel and development of the Government's agricultural research, extension, and education institutions were paramount among the needs of the country in 1958, and assistance was requested of USAID in these areas. While food import assistance could fill consumption gaps in the short run, in the long run the country needed the institutional capability to train farmers and provide them with the technology to adequately use land resources to their full potential for food production. Self-sufficiency in food production was a primary goal in agriculture for the Government.

III. THE AGRARIAN STRUCTURE AND SOCIAL REFORMS

A. Colon Lands

At independence, some 4,000 European farmers owned approximately 850,000 hectares of the best agricultural land in Tunisia. Around 5,000 Tunisian farmers operated large- and medium-size farms, and 450,000 Tunisians owned or leased small holdings for subsistence farming.7/ The balance of the rural working population followed pastoral pursuits, worked in forests, practiced pastoral nomadism, or served as rural laborers. The European colony in Tunisia consisted of 180,000 French, 60,000 Italians, and small numbers of others. The total population in Tunisia was approximately 3,783,000.8/

The European farmers were permitted to continue to operate their farms under an agreement between the Government of Tunisia and the Governments of France, Italy, and England, which provided for a gradual

phaseout. Tunisia was to reimburse owners following the transfer of lands. However, as a result of the political tensions arising from the Algerian War in 1964, President Habib Bourguiba broke the agreement with France and announced plans for immediate evacuation of colons and taking over the land. The decree was extended to all foreign-operated land. By this decree this land was brought under state control.^{9/}

There followed a period of economic chaos in Tunisia. The Government attempted to organize and manage the land resources occupied by the colons. Its efforts were aggravated by the exploitation of land resources, equipment, and facilities by the colons during the several years prior to their departure in anticipation of eviction.^{10/} Cereal production declined dramatically from an average of 737,582 metric tons during the five-year period ending in 1956 (see Appendix D, Table D-3), to an average of 471,000 metric tons during the five-year period following eviction of the colons, 1965-1969 (see Appendix D, Table D-4). This production was not adequate to meet consumption needs (561,000 metric tons in 1966) and provide security stock.^{11/} Wheat yields had declined from approximately 8.5 quintals (10 quintals equal 1 metric ton) in 1955 to around 6 quintals per hectare for bread wheat and from around 4 quintals to 3.5 quintals per hectare for durum wheat by 1966 (see Appendix D, Figure D-5).^{12/} Cereal production averaged only 552,000 metric tons per year from 1959 to 1961, which was about 50 percent of the Government's estimate of projected needs. Production of other crops had also performed poorly (see Appendix D, Table D-18).^{13/}

For a time, President Charles de Gaulle broke off trade relations with Tunisia, closing its market for wine, olives, and durum wheat, which the Tunisians had continued to export from colon production. However, economic and political relations were restored gradually, and France continued a large, technical assistance program, particularly in education. However, French civil servants were replaced rapidly by Tunisians.

B. Cooperatization of Land Holdings and Other Social Reforms

The agrarian structure inherited from the French Protectorate and the social reforms carried out by the Tunisian Government after independence were factors which influenced agricultural development, the manner of

implementation of Projet Ble' (the French name given to the Wheat Development Project), its rate of progress, and the degree of its success to date.

Many of the social reforms, committed to by the Neo-Destorian Party and carried out by President Bourguiba soon after independence, had significant implications for the country's future development, particularly in the agricultural sector. The President abolished or revised regulations and customs that he considered outdated for a modern country: religious courts were abolished; laws governing marriage and the status of women were revised, abolishing polygamy and providing legal rights for women comparable to those in France; and wearing of the veil was prohibited. At a later date, abortion and birth control were legalized, thus providing the legal basis for a family planning program which since has been acclaimed successful. The religious school of the "Zituna Mosque" was absorbed into the University of Tunis. The habous system of landholdings was abolished, which released 300,000 hectares of land in the Mejarda valley for distribution.^{14/ 15/} While this land was at first cooperatized, much of it was eventually distributed to private individuals.

The philosophy of the Neo-Destorian Party was based on a socialistic system for economic development of the country and for achievement of equitable distribution of income. Cooperatization of land holdings and private businesses was chosen as the model for creating a socialistic system. This had been envisioned by Ahmed Ben Sala, architect of Neo-Destorian socialism, as a means of efficient management of land resources, of marketing the products, and of achieving social equity among its participants. The program, implemented in the early 1960s, failed for a number of reasons, but primarily because it destroyed the individual initiative of the producers and entrepreneurs. Inefficient management and centralized Government controls were other factors. Production declined and agricultural markets dried up. The economic consequence and public resistance caused the Government to curtail the movement in September 1969.

Since 1969, the Government has followed a mixed policy of "coexistence of the private, public, and cooperative sectors." While 347 cooperatives were dissolved after 1969, and their 200,000 hectares of land placed temporarily under State control, 147 cooperative production units have remained in control of 114,000 hectares of this land in the North.^{16/} Table D-19 in

Appendix D shows the evolution of State-controlled land from 1964 to 1971.^{17/}

The Wheat Development Program was conceived and initiated at the peak of cooperative reform in 1966. If the system had not been changed, neither agricultural development nor the program would have made the progress that they have to date. The change in the Government policy regarding cooperatives was critical for future development, but overcoming the effects of the program and creating public institutions to adequately serve farmers have taken years. The rate of progress of Projet Ble' can be correlated with these changes.

After 1969, the Government passed laws and established procedures for divesting itself of ownership of much of the State-held land, and for initiating a program of distribution to private holders. It also gave owners who had joined cooperatives the option of withdrawing. A National Land Commission was created in 1972 to establish procedures, adjudicate claims, and authorize official transfers. Land registration and certification of ownership require a land survey. Such certification is an important criterion for credit. Surveys have been slow. As a temporary measure for legalizing ownership for new owners, regional Agricultural Commissioners have been authorized to issue a temporary certificate for credit purposes. This has been an important criterion for credit eligibility with the agricultural bank.^{18/}

IV. MANAGING THE AGRICULTURE SECTOR UNDER A COEXISTENCE POLICY

The Government has followed the "coexistence" policy announced by President Bourguiba, toward the public, cooperative, and the private sectors. The economy is regulated by control of prices and of distribution of commodities. This is done through parastatal commodity offices which purchase and distribute commodities at controlled prices. These regulations have had a direct bearing on the progress of the Wheat Development Program. The Government also controls interest rates and subsidizes credit. The imported cost of such items as irrigation pumps and tractors is subsidized through investment credit provided by the Government through the National Bank of Tunisia (BNT). The Government also exercises controls through regulation of foreign exchange and imports (licensing); management of exports and imports; management and operations of State farms; ownership in parastatal enterprises, including banks (usually

51 percent Government and 49 percent private ownership); and control of State-owned lands.^{19/}

There are a number of parastatal commodity offices whose functions are similar in respect to Government regulations, although their other functions vary according to the physical characteristics of the commodity. Principal commodity offices are the Office of Cereals, which is the commercial organization for purchase and distribution of cereals, pulses, and nuts; the Office of Oils, which has a similar function for olive and other oils; the Office of Wine; and the Office of Livestock and Pastures.

In addition to performing a Government regulatory function, some of the offices also perform research, experimentation, and extension functions, and provide technical assistance to producers of the commodities. The Office of Livestock supervises the functions of a parastatal company in the management of large Government slaughterhouses and of the processing and wholesaling of meat, whose price is controlled.

Fresh fruits and vegetables enter local markets through private enterprise, cooperatives, and associations, where taxes and fees are levied.

The broader responsibilities of the Office of Cereals, established in 1962, were the following:

- Regulate prices and price margins and provide subsidies for each operation of processing, distributing, and retailing of cereals, nuts, and pulses;
- Distribute seeds, fertilizers, and agricultural chemicals (insecticides and herbicides) to farmers;
- Purchase, store, and distribute grains and nuts;
- Allocate and sell grain to the large mills;
- Regulate the wholesale, distribution, and retail sales of processed products;
- Estimate consumption requirements of cereals, determine import requirements, and manage cereal imports; and
- Maintain national cereal reserves.

It is assisted in these functions by State agencies, private enterprises, and central cooperatives, which include the Central Cooperative for Seeds (COSEM), the Central Cooperative for Wheat (COCEBLE), and the Central Cooperative of Major Crops (CCGC).^{20/} The Office of Cereals purchases cereals from producers and sells them to large Government-controlled and private mills for processing and resale to bakeries and the pastry industry. The price margins allowed processors to include a subsidy to maintain a low and stable price for bread for consumers.

The Wheat Development Program has been identified with the Office of Cereals since 1972 when Projet Ble was transferred to the Office from the Ministry of Agriculture, where it had been placed for the first years. The Office of Cereals took on additional functions to support the Program, including experimentation, or applied field testing, demonstration, and extension activities for wheat and barley. A technical division was established for this purpose. Staffed with 19 technicians (in 1972), it is still carrying on the technical activities of Projet Ble, with the exception of actual genetic and agronomic research. Research is conducted at the National Agricultural Research Institute of Tunisia (INRAT) with the cooperation of the National Agricultural Institute of Tunisia (INAT), which is the national agricultural university. Research by these two institutions is a cooperative activity. Two agriculturists with the Technical Division of the Office of Cereals are detailed to INRAT to assist in research activities.

The persons responsible for planning the project in the beginning were seeking an action-oriented agency that had sufficient independence from normal Government administration for flexibility in decision-making and management. Also, they sought integration of research, demonstration, and extension. With 102 outlets in rural areas, the Office of Cereals had a channel for supply of inputs to farmers on credit terms. It was the only agriculture organization that was national in scope and could effectively reach farmers in an extension program. There was no national extension system. Given the condition at the time, and lack of options, the decision to place the Program in the Office of Cereals was a logical one. Much credit for the current success of the Program on the extension and input side can be given to the Office of Cereals. Nevertheless, some of the management and institutional weaknesses of the Program also focus on this Office, such as inadequate supplies of

fertilizers and herbicides, shortage of storage space to handle large harvests, and lack of storage facilities in remote areas. However, the Office of Cereals cannot be blamed for all the shortages to farmers. Broader Government policy on allocation of foreign exchange for imports is a factor which has also limited supplies. Overall, the rate of success of the Program, which has been slow, relates to institutional development factors associated with gaining experience.

Three of the Tunisian counterparts who worked with American and Australian scientists on the project are still carrying on activities started by the project, following the procedures introduced by advisors. These include conducting field trials on private farms, holding demonstrations for farmers, and feeding back adoption experience and problems to the central research station, INRAT.

The Office of Cereals provides some Government-financed agricultural credit in kind (fertilizers and seeds) to small farmers by exchanging higher priced certified seeds of improved varieties for an equal amount of lower priced wheat produced by the farmers. This program is aimed at encouraging small farmers (below 40 hectares for cereals) to adopt the new wheat varieties and technological package.

Private enterprise and cooperatives, following the philosophy of coexistence, also function in the marketing and distribution system, primarily in the processing area, and somewhat in seed production.

The Government has allowed a large portion of the grain supply, especially durum wheat, to be traded and priced freely in the open, or parallel, market. This grain and that consumed at the farm are processed in small local mills. A principal reason for this exception is the need to protect autoconsumption of farmers. Another reason is said to be the shortage of storage space at peak periods.^{21/} The Government plans to establish new outlets to improve coverage of the rural area and increase the number of outlets from the present number of 102.^{22/}

A parastatal society, the Tunisian Chemical Fertilizer Company (STEC), imports fertilizers and fertilizer ingredients manufactured abroad. Tunisia exports phosphate rock and manufactures superphosphate fertilizer for its own use. The three principal fertilizers used

for cereals are superphosphate 45 percent, superphosphate 16 percent, and ammonium nitrate 33.5 percent. The availability of these fertilizers has been critical to the program.

Since forage crops are produced mainly in rotation with cereal crops, there is an overlap in the extension functions of the Office of Cereals and the Office of Livestock and Pastures. Coordination is at the regional or governorate level.

The regional Agricultural Commissioner, who reports administratively to the governor of the governorate, and technically to the Ministry of Agriculture, has a staff which includes extension agents. One of their functions is to coordinate the work of the representatives from the various offices and agencies of the central ministries in transmitting information to farmers. They supervise agents stationed at the lowest administrative level, which was called a sheikdom in the 1960s but is now known as a mecheikhat. It is the goal of the Government to have one extension agent stationed in each of the 500 mecheikhats as cells are created. To date, 150 such cells have been established and staffed with 81 extension agents. The agent's role is to provide a channel for information to farmers in the mecheikhats, a role equivalent to that of the U.S. county extension agent.

The organizational approach and the methods being used for extension in Projet Ble' by the Office of Cereals have been adopted by the Ministry of Agriculture for a national extension system, operated through the regional Agricultural Commissioners. Field days and private farm demonstrations introduced by Projet Ble' are being adopted by the Ministry of Agriculture, other Government agencies, and the Regional Agricultural Commissioners.

V. LAND TENURE INFLUENCES ON ADOPTION OF NEW TECHNOLOGY

Sales and transfers of State land to private ownership have been slow. Land survey requirements have been cited as a retarding factor but other factors have undoubtedly complicated transfers.

In 1971, two crop years after the change in the cooperative program, there were 320,000 private farms on 4,517,000 hectares (See Appendix D, Table D-20). State and cooperative land covered 830,000 hectares. There

were 400 private farms averaging 500 hectares in size and 1,150 farms ranging in size from 200 to 500 hectares. The balance of the farms averaged less than 200 hectares. The greatest number of farms (131,600) was in the one- to five-hectare range. The profile of farm sizes varies from north to south in Tunisia as the climate changes and rainfall patterns diminish southward towards the Sahara. Sizes of minimum farming units increase as rainfall diminishes southward (See Appendix D, Table D-20).^{23/}

As of December 3, 1977 (last report available), the Government of Tunisia had sold 143,277 hectares of land since 1972. Of this amount, approximately 85,000 hectares were sold to 8,741 individuals who were agricultural workers, former cooperative members, graduates of agricultural schools, and small and medium holders.^{24/}

One constraint to development and adoption of new technology identified in the agrarian structure is the fragmentation of holdings. Basically, this has resulted from hereditary practices over generations. Fragmentation imposes an additional cost in use of labor, animal power, and mechanical equipment. Parcelling of land is particularly prevalent among small farms of less than 50 hectares, and is great even among owners of 20 hectares and less where holdings are often broken up into four to six parcels, each separated by a distance of up to a few kilometers. In 1976, the Ministry of Agriculture reported that 326,000 farms had 1,383,000 parcels, an average of 4.2 parcels per farm. On the tour of this team throughout much of Tunisia, we visited only one small farm that was not fragmented. This was a farm of about 20 hectares in the southern, arid region around Sbeitla. Regional Agricultural Commissioners whom we visited cited this problem as a major impediment to efficient agricultural development among small and medium holders.

The problem of fragmentation is reduced somewhat by land rentals in which farmers attempt to accumulate sufficient contiguous surface adjacent to their own land to form a more efficient unit for farming or to expand their operations. A survey in 1973 for the crop year 1972/1973 showed that over 50 percent of the 375 farms surveyed rented some land. The percentage of small farmers (below 40 hectares as defined in the survey) renting land was high in comparison to percentages among medium and large farmers. Also, large farmers did not dominate the land market. Adoption of high-yielding

varieties of wheat was positively associated with the rental of land and tractors, the availability of which was not found to be a constraint. Important to note is that a greater percentage of area planted in high-yielding varieties of wheat was found on small farms than on medium and large farms.^{25/}

A private farm of 1,000 hectares in Jendouba which we visited represented the best in private farm management in Tunisia. The young farmer, a graduate of an agricultural university in France, manages the farm using the latest technology in new varieties, insecticides, herbicides, and fertilizer. The farm was equipped with a machine shop, permitting him to keep tractors in operation for as long as 15 years. He felt that he was ahead of the Government in technology, using new wheat varieties, and reproducing his own seeds. His wheat yields were reported to be 25 to 35 quintals (2.5 to 3.5 metric tons) per hectare. He was even drilling his own deep wells for irrigation water for growing sugar beets. All he wanted from the Government, he said, is the right price for his products.

Small farmers on similar land near this large farm were following his practices in use of improved seed varieties and other technology, but they had obvious limitations in both land and capital resources.

State farms were reported to be doing better for the most part than cooperative production units, but not as well as private medium and large farms, according to Government agricultural technicians contacted.

One can argue the social inequity of a single private holding of 1,000 hectares of the best land in a country of scarce land resources, where 130,000 farmers operate less than five hectares on marginal land. This same argument of inequity would apply to an Iowa farmer, owning 15,000 acres of the best corn and soybean land in the United States versus a 10-acre farmer in the Appalachian mountains in the eastern United States trying to grow corn for a living. Changing this "inequity" would have just about as much possibility in Tunisia now as it would have in the United States.

The opportunity, which may have existed after independence in Tunisia, of carrying out a rational reallocation of land has been lost. Such land reform would not be possible now without a major political upheaval which would set development back tremendously.

Attention is being given to small farmers in a number of programs, and surprisingly, the trend of adoption of new varieties and use of fertilizer exists among them in good wheat growing areas where credit and inputs have been made available. Our casual observations correspond to findings of Gafsi and other economic surveys.^{26/}

The size of farm and the resources available to the farmer influence his decision on investment and the type of technology to use. Farmers operating more than 40 hectares are eligible for bank credit. Farmers operating less than 40 hectares must depend on limited credit in special Government programs, described in the credit section, and on noninstitutional sources for credit. Nevertheless, farmers in the small category do have some viable options. They can rent their land out, migrate, and work in other activities in Tunisia or in Europe as thousands have done and are doing. They can mechanize their operation by renting machinery. Rental of farm machinery creates the potential for expanding the size of farm units by renting additional land. The other option is to sell the farm. All these are happening.

Small-farm operators traditionally used draft animals (bullocks, horses, and camels) for plowing, while the Europeans left a tradition of mechanization on medium- and large-farm units. During the past two decades, the Government has sponsored a mechanization program through subsidized credit to eligible cooperative and private farmers. Approximately 2,000 tractors have been imported per year since the early 1960s, along with other agricultural equipment.^{27/} Most of these were imported under USAID, World Bank, and other development loans.

The first farms mechanized were the large private, cooperative, and State farms, which had actually been mechanized by colons and a few large private farmers. As a result of the Government program, tractors for plowing and combines for harvesting became available for rent at reasonable rates from private farmers and from Government-supported machinery supply and maintenance cooperatives (Societe Nationale de Motoculture or SONAM). That is, private individuals find it profitable to do custom plowing and harvesting, normally as a part-time business, combined with operating a farm often too small for economic and efficient use of the equipment. Availability of rental equipment, the shortage of labor in rural areas and the inefficiency of animal plowing, the potential for expanding the size of farm units through rental, and savings in feed, labor, and

maintenance costs for draft animals have influenced mechanization of small-farm units as well as medium-size farms. The need for speedy seedbed preparation to take advantage of rain and of the optimum growing season is another factor which is important for any variety of wheat, but is critically important for use of fertilizer and the new, high-yielding varieties.

The use of machinery on small and medium farms appears to have preceded the use of new varieties in wheat growing areas. It was reported to the team while on field visits that many farmers on less than 50 hectares of land had used tractors for seven to eight years and had adopted new varieties only lately.

Ben Senia described the major farm types in Tunisia in reference to cereal production as modern (over 100 hectares), mixed (20 to 100 hectares), and traditional (less than 10 hectares).28/

There is evidence in a credit program that farms of 20 to 50 hectares in areas of adequate rainfall and fair soils, even on hillsides, have the potential, with improved technology, for producing some marketable surplus where farming of wheat is integrated with livestock production and cultivation of forage crops. This type of integrated farming is found even on units of less than 10 hectares, which constitute 18 percent of the total wheat area (see Appendix D, Table D-22), although in dryland cereal production these are primarily subsistence farms. It is generally accepted that a five-hectare wheat farm on marginal, hilly land provides limited subsistence unless the operation is extended through rental of additional land. Given the age of farmers in Tunisia (average, 55 years), and the rural exodus, the process of land consolidation appears to be taking place through sale and rental of small plots (see Appendix D, Table D-21), although the process is slow.29/

The agrocombinats, pilot farms, and cooperative production units (UCP) cultivate an average of 65,000 hectares of wheat annually, or about 4.5 percent of the total cereal area. Farms below 50 hectares in size produce a small portion of the total wheat production that was marketed, according to an evaluation by the Subcommittee on Field Crops for the Ministry of Agriculture in 1980.30/

Some idea of the economy of small farm operations is gained by the extent of off-farm employment and the

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extent of mechanization. A survey conducted in 1980 showed that 47.6 percent of farmers operating units less than 10 hectares and 43.1 percent of those operating units less than 20 hectares engage in other economic activities. Overall, 40.5 percent of all farmers have other work (see Appendix D, Table D-21).^{31/} A large portion of small and medium farmers use tractors for seedbed preparation, estimated at 83 percent of cereal areas despite the fact that 79 percent of cereal area is on small and medium farms, according to a study reported in 1981.^{32/} Also, 1,080 farmers on less than 10 hectares owned tractors, out of a total of 10,190 tractor owners (see Appendix D, Table D-23). Since the ownership of a 45-horsepower tractor by a farm operator of less than 10 hectares would not be economically feasible solely for his own use, one must conclude that he rents his tractor out. The importance of this information is that at least one-half of small farmers have been sufficiently freed by mechanization of their farms to have time for other employment, and that other employment is available for many to increase their income.^{33/}

Farmers operating less than 50 hectares plant a large portion of the cereal area in Tunisia. They planted 700,000 hectares and produced an estimated 316,000 metric tons of cereals in 1980. However, production was little more than enough for subsistence, with only 10 percent of production from these size farm estimated as entering commercial channels. This may be a conservative estimate in view of the extensive use of rental tractors and other inputs requiring cash payments. Cereal crops were produced (1976-1979) on an average of less than half of the farm land in each farm surveyed in 1980. The amount of area devoted to cereals declined with the increased size of farm: 1.54 hectares in cereals on an average farm size of 3.86 hectares (in the less-than-10 hectares category); to 2.37 hectares on an average farm size of 6.19 hectares (in the less-than-20 hectares category); and 12.56 hectares in cereals on an average farm size of 33.83 hectares (in the 20-to-100 hectare category) (see Appendix D, Table D-23).^{34/}

From the standpoint of commercial production of wheat to meet consumption needs of the country, the Government is relying on medium and large farms in areas of adequate rainfall and better soils of the north and north-central part of the country. These farms produce 90 percent of the products sold.^{35/} They represent the best land resources of the country, and the medium and large farmers are the leaders in adoption of new technology.

VI. RESEARCH AND THE NEW TECHNOLOGY

The rate of development of research results and the characteristics of the technology generated have been critical to the rate of change and success in the adoption of the new wheat varieties and the accompanying technology.

Tunisia was already using mechanized farming, fertilizers, and crop rotation on the former colon and large private farms brought under cooperatization when the project was started. The new technology dealt with introducing, testing, adapting, and genetic crossing of the wheat varieties developed from Norin 10 brought from Japan in 1947 to the United States, which resulted in crosses that improved wheat yields there.^{36/}

Dr. Norman Bourlaug also worked on the Norin-10 at CYMMIT beginning in 1954. He developed crosses which incidentally turned out to be relatively photo insensitive to the length of the day. This occurred as a result of doing research at two different latitudes and elevations in Mexico, transferring seeds back and forth. This day-length insensitivity permitted adaptation of these varieties in varying latitudes around the world. They were successfully introduced into India, Pakistan, and Turkey in the early 1960s. Dr. Bourlaug later was awarded the Nobel Prize for his efforts.^{37/} Word of this success had reached Tunisia by 1965.

The dwarfness of these varieties and their sturdy stem prevent lodging (falling over) during storms and heavy rains, and permit greater utilization of nitrogen for developing the wheat grains, thus producing more grain and less chaff. The varieties also have the advantage of a shorter maturing period, which is called "precocious" by breeders. These characteristics were important to Tunisia because early harvesting would avoid about two weeks of the hot, dry period of July. The varieties were also resistant to certain diseases and pests. However, early bread wheat varieties developed in Tunisia by the Program were more sensitive to drought than traditional varieties, as the originally introduced varieties had been adapted to irrigation,^{38/} although some dryland varieties, developed for parts of Turkey, were also utilized.^{39/} The new varieties also required appropriate agronomic practices with correct management of fertilizers and weed control. These sensitive characteristics would have caused failure if a genetic research program had not accompanied the technology program. This research overcame or reduced the

sensitivities of the new dwarf wheat varieties. Also, the Program would have had less success if genetic research had not also been started on durum wheat.

This research breeding program was focused first on improving the varieties of soft wheat and later (1970/1971 crop year) of durum wheat. Durum wheat is preferred by Tunisian farmers because of its hardness in this environment and its higher price than bread wheat on the market. Preference for durum for home consumption in couscous, spaghetti, and noodles has been traditional, but food habits are changing due to monetization of the rural area and the effects of urbanization from rural exodus. The continuation of this genetic research has been the most critical element in the Wheat Development Program. New varieties are being developed and tested in various regions on private farms and released every two or three years. As soon as sensitivities are observed, the breeding program works on crosses to reduce the sensitivity. Almost 90 to 95 percent of all the new crosses, both durum and bread wheat varieties, originated from materials introduced from CIMMYT and Italy.^{40/}

Achievements since the project terminated are associated with further improvement through research on both bread wheat and durum wheat varieties. Also, intensification of extension demonstration efforts has increased farmers' knowledge of the use of the new technology.

VII. WEATHER AND INVESTMENT RISKS

Potential for increasing incomes has been a driving force, as one would expect.^{41/ 42/} However, variability in weather and risk of investment loss in expensive inputs such as fertilizer have had a dampening effect on the rate of investment and of adoption of new varieties. Years of little rainfall or inadequate distribution of rain during critical seeding and growth periods can be disastrous to farmers (Tables D-6 and D-15). The small subsistence farmers risk the most: their source of food. Risk aversion has been an important factor associated with nonadoption and has been identified in analysis and reported in economic studies. The risk was greater in the early days when the new soft wheat varieties, more susceptible to drought than traditional durum wheat, were being used. Farmers who wanted to try the new varieties hedged on adoption by planting both old and new varieties. Lack of experience caused errors in judgment in the allocation of inputs in years of unfavorable weather, (1976/1977 for example).

This caused losses in investment which were felt heavily by small producers.^{43/ 44/}

High rainfall variability in Tunisia, of course, is always a critical factor in a farmer's decision: first, on when and if to plant; second, on what crop to plant; third, on the area for the crop, depending on the tillable area available to the farmer using his own and rented land; and fourth, on whether and how much fertilizer (if available) to use at planting and subsequently during critical stages of growth (at planting time and after plant growth at tillering). If there is lack of moisture at planting, the farmer risks losing both the seed and any fertilizer he may apply. The same is true during periods of growth. If there is insufficient moisture, application of nitrogen fertilizer may be wasted. Water in the soil is required for the plant to utilize the nitrogen. It is important that farmers get their seed into the soil as soon after a rain as possible. Time is important, which has influenced the use of tractors to replace animal traction in seedbed preparation.^{45/}

A 45-horsepower Ferguson tractor can plow a hectare of dry upland in approximately 2 1/2 hours. It takes a team of two bullocks, of the type traditionally used in Tunisia (horses and camels are also used), approximately 41 hours to plow the same one hectare of dry upland.^{46/}

A. Price Influences on Production and Alternatives

A wheat farmer has some options in what type of cereals and some other crops to produce, although the options are limited by the regional location of the farm, type of soil, weather, and other factors. Prices of the commodities are very important among these factors. The price margins among durum, soft wheat, and barley influence the farmer's decision. Prices of forage crops, such as oats, vetch, and grain legumes, also influence the farmer's decision, depending on available resources. These other crops are currently receiving emphasis in the Government's pricing structure in efforts to stimulate livestock production. Grain legumes, vegetables, and forages are competing with cereals in areas of higher rainfall and on some irrigated land which has been used in the past for wheat. However, some of these crops can be complementary rather than competitive to wheat if grown in proper rotational systems with wheat to replace the weed fallow system, which is being encouraged.

Pricing policies in the past have been identified in studies as constraining adoption of new technology.^{47/} This was also a topic of discussion at the seminar on cereals conducted by INAT on April 12-16, 1982, at Tunis, attended by the evaluation team. It was reported that at one point in the 1980s, the price of wheat straw competed favorably with the price of the wheat grain.

Until after 1979, prices of cereals to farmers had not kept pace with inflation in Tunisia and with world wheat price trends. The average annual rate of inflation was 7.5 percent during the period 1970-1979.^{48/} The Government's policy of maintaining low producers' prices and subsidizing bread through subsidies to wheat processors has been consistent and effective for this purpose.

Prices of cereals to farmers remained constant from 1970 through 1973, a four-year period (see Appendix D, Table D-2). The price of durum wheat during this period was TD 4.800 (Tunisian Dinar, equal to U.S.\$1.80 in 1982) per quintal, or TD 48.000 per metric ton; bread wheat was TD 4.300 per quintal, or TD 43.000 per metric ton; barley was TD 2.800 per quintal, or TD 28.000 per metric ton.

The depressed prices of cereals during 1970-1973 certainly provided inadequate incentives to farmers to invest in new risks. This explains to some extent the slow rate of adoption during this period.

Prices were increased in 1974 and 1975, reaching TD 6.600, TD 6.000, and TD 4.500 per quintal for durum, bread wheat, and barley, respectively. Annual price increases have been made since 1977. The last price increase was in 1982 when durum reached TD 110 per metric ton, soft wheat was TD 100 per metric ton, and barley was TD 80 per metric ton.

Tunisian wheat prices (farm price adjusted for 12 percent overhead charged by Office of Cereals) have generally been lower than and lagged behind international prices, and the margin between durum and soft wheat has been greater in the international market. The 1981 price differences illustrate the point. Tunisian wheat prices to farmers in 1981 were TD 96 per metric ton for durum and TD 87 per metric ton for soft wheat. In U.S. dollars, this was equivalent to approximately \$173 per metric ton for durum and \$156 per metric ton for soft wheat. The prices (cost, insurance, and freight, or c.i.f.) in February 1981 for these two wheats imported from the United States to Rotterdam were \$307 per metric

ton for U.S. durum, and \$215 per metric ton for U.S. soft wheat.^{49/} The increase in Tunisian prices in 1982 narrowed the margin somewhat, especially for bread wheat.

The basic support price levels for wheat in other countries offer a more precise comparison. The support price in the 1980/1981 crop year for bread wheat in EEC (European Economic Community) countries was U.S. \$246.74 per metric ton.^{50/} This was 63 percent higher than the price for bread wheat in Tunisia in 1981.

The Government has effectively insulated Tunisian consumers from international inflation and the fluctuation of exchange rates of the U.S. dollar by its price policies on wheat and its subsidization of the price of bread. This policy has maintained the price of bread at a relatively low and stable level. The effects of this policy on the industrial sector, the wage earners, and the urban community have been good. It has helped keep wages low and thus stimulate industrial development. As pointed out by Hyslop, wheat is the industrial wage good in Tunisia.^{51/}

On the other hand, the depressed prices were a disincentive to farmers to make risky investments in new technology in the earlier years of the Wheat Development Program, particularly the first few years before more hardy varieties emerged from the genetic crossing pattern.

With improvements in varieties and other technology and with further education of the farm population, the degree of risk has been decreased. Also, increases in wheat prices in 1982 provided additional incentives.

With improvement in yields, farmers' incomes on the same area of land can increase. Once farmers gain experience with increased yields, increases in production will be a compensating factor. That is, the combination of yield, prices of wheat, and cost of inputs will determine farmers' incomes, and thus incentives.

Another factor in pricing which has also limited incentive to farmers has been the Government policy on timing of price increases. The Government had been following the practice of the French Protectorate of announcing the price of wheat at harvest time, months after the farmer had made his decision, which was at planting time. Beginning in January 1981, the Government announced the new higher cereals price for the following 1981/ 1982 crop year. The Government now plans to adjust the price annually before planting.^{52/} The price

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increase for 1982 (see Appendix D, Table D-2) is offset somewhat by an increase in the price of fertilizer (see Appendix D, Table D-24), and a small increase in tax on cereals.^{53/} Fertilizer and insecticide prices also have been kept lower than import prices through subsidies (see Table D-24). The Government is being encouraged to reduce subsidies, and the price adjustments in cereals and fertilizers for 1981/1982 appear to be a first step in this direction. The increase for superphosphate 16 represents a new policy of discouraging use of this formula because of its lower cost effective ratio due to higher transport costs, and of encouraging the use of the 45-percent formula for its greater concentration.

The variation in area planted in the two wheats and barley has been influenced by price margins for these crops, as well as other factors mentioned. Area planted in cereals has fluctuated during the past four years (see Appendix D, Table D-11). The area planted in durum wheat decreased by about 200,000 hectares during the period 1978-1981, while the area in soft wheat decreased after 1973 and only slightly after 1978.^{54/} Area planted in soft wheat had decreased more than that planted in durum wheat in previous years (see Appendix D, Figures D-1, D-2, and D-3).

Comparison of area planted and production during an 11-year period prior to and after the project started (1960 through 1970 and 1971 through 1981) shows that the average area devoted to bread wheat decreased annually by 4,000 hectares during the second period (see Appendix D, Tables D-1 and D-25) from the annual average during the previous period; whereas the average area devoted to durum wheat increased annually by 132,000 hectares during the second period over the first, and barley remained the same. The situation has changed during the past four years, however.

The average annual area planted in durum wheat during 1978 through 1981 declined by 15,000 hectares from the average annual area in 1971 through 1981 (see Appendix D, Table D-26). Bread wheat area was less by an average of 65,000 hectares during each of the four years 1978 through 1981 as compared to the average annual area during 1971 through 1981 (see Appendix D, Table D-26). During the past two years (1980 and 1981) bread wheat area has been less each year by about 15,000 hectares, and durum wheat area has decreased by approximately 200,000 hectares for each of the two years compared with each of the previous four years, 1976 through 1979 (Appendix D, Table D-1). The average annual barley area

increased by 97,000 hectares during 1978 through 1981 above the average annual area during 1971 through 1981 (Table D-26). It reached a high point in 1979 and dropped 100,000 hectares below this point in both 1980 and 1981, bringing the average for each year, 1980 and 1981, to 20,000 hectares greater than the annual average of each of the previous four years, 1976 through 1979 (Table D-1).

Despite the decrease in area planted in wheat during the past two years, there has been an increase in production and yields (see Appendix D, Table D-11a and Table D-11b, respectively). Production and yields of both durum and soft wheat increased in 1980 and 1981. This improvement over the two previous years can be attributed to increases in prices, timing of announcement of the price increase, increased use of improved high-yielding varieties, increased use of phosphate and nitrogen fertilizer, better agronomic practices, and further improvement in varieties (overcoming or decreasing sensitivities). Favorable rainfall was also important, but there has been favorable weather before without the spectacular average yields obtained in 1980 and 1981.

This increase in adoption of high-yielding varieties has been gradual. The area planted increased from 17 percent in 1977 to 35 percent in 1981 for durum wheat, and from 43 percent to 68 percent for soft wheat during the period (see Appendix D, Table D-27).^{55/} New durum varieties used during the past season were Karim 79 and Ben Bechir 80; new soft wheat varieties released were Salammbo 80 and Tenit 80 (Table D-9). All these varieties are new crosses which have embodied drought- and disease-resistant characteristics of older crosses and new imported varieties.

B. Input Supply

The Government has sensitized the farmers to the value of using fertilizer, improved varieties, and other inputs (Appendix D, Tables D-12, D-13, D-27a, and D-27b). However, the extent of demand was not expected, and demand has exceeded supply. Shortage of inputs has been a major constraint during the past four years.

The shortage of fertilizer has limited its use during the past two years as has the shortage of herbicides. Weed control, a major factor affecting production and yields, is beginning to be understood and practiced by Tunisian farmers. Use of herbicides has increased dramatically (see Appendix D, Table D-27b). Like

fertilizer use, a major limitation on consumption has been shortage of supply. While this concept of weed control in farming is new to most Tunisian farmers, and considerable time will be required to acquaint them with the correct practices, the current demand for herbicides far exceeds the supply. The factor of weed control, on the other hand, is a difficult one for adoption. It requires careful management. The use of shorter stem varieties of wheat and of heavy doses of nitrogen often brings forth weeds that the new user has never seen. The taller traditional varieties smother out some of the weeds, a factor in their favor.

Shortage of fertilizer and herbicides was thought to be attributable to institutional management, but has been identified more recently as related more to a policy constraint. The policy relates to allocation of foreign exchange for importation of fertilizer. Fertilizer was given lower priority for foreign exchange than other items. USAID is now developing a PL 480 program which will assist in this area, and the Government plans to increase imports of nitrogen fertilizer. The program will be focused on increased nitrogen importation and use.^{56/}

VIII. ACCELERATED EXTENSION AND RESEARCH ACTIVITIES (1979-1982)

The Office of Cereals is following an intensive schedule of field testing and demonstration days, both for the regional extension agents (at the governorate level) and for farmers. The Agricultural Commissioners whom we visited in the Beja and Jendouba Governorates, the two regions with the largest wheat production, informed us that the Regional Offices are conducting intensive campaigns by television, radio, and public meetings using audiovisual techniques, farm demonstrations, farm visits, and newspapers to inform farmers (see Appendix G). They feel that they have "sensitized" farmers to the advantages of new varieties and how to cultivate them. This accounts for the increased demand for fertilizer, insecticides, herbicides, and high-yielding seeds which the Government cannot meet. As one Tunisian put it, "Before, the Government was pulling the farmers along; now it's the farmers who are pulling the Government."

IX. AGRICULTURAL CREDIT

The availability of agricultural credit either in cash or in kind has accompanied the use of seeds and fertilizer and other inputs. However, credit has not always been available for small and medium farmers, although the lack of availability of fertilizer and herbicides for use as credit has been the major limiting factor. Credit procedures have been cumbersome and complicated. Large farmers and cooperatives with access to bank credit have been in a better position to get credit and to exercise first claim on available inputs. However, supplies have been short of meeting their needs too.

The National Bank of Tunisia (BNT), the agricultural bank, provides most of the financing to the agricultural sector. Credit is also provided through Government offices and agencies. The BNT's portfolio of lending to farmers has increased dramatically in the past decade. Its record of lending to agriculture from 1965 to 1971 (see Appendix D, Table D-28) averaged TD 5,812,000 per year in short-term credit and TD 3,767,000 per year in medium- and long-term loans. Most of the lending until 1970 went to cooperatives. Beginning in 1971, lending to cooperatives became a small percentage of the total.^{57/} In 1980, BNT extended TD 20,404,000 in short-term agricultural credit (see Appendix D, Table D-29). Of this amount 56.7 percent went to cereal producers (TD 11,561,000). The record in 1980 represented an increase of 40.3 percent above the 1979 record (TD 8,241,000).^{58/} Medium- and long-term loans had risen from TD 7,432,000 in 1971^{59/} to TD 19,213,000 in 1980, (Table D-29)^{60/} representing an increase of 28.3 percent compared to the credit extended in 1979. The BNT also provides loans for commercialization of agricultural commodities, including the marketing operation of the Office of Cereals. In 1980, the BNT financed cereal commercialization in the amount of TD 30,991,000^{61/}.

BNT's sources of financing for agricultural credit includes special Government-subsidized funds (FOSDA)^{62/}, its own resources, and the Central Bank of Tunisia (BCT), which discounts some of BNT's loans. For short-term credit in 1980, 18.2 percent came from the Government Special Fund and 61.5 percent from BNT's sources. In the case of investment credit, most of the medium- and long-term credit came from FOSDA for financing irrigation development, livestock, tree plantation development, construction, and fisheries.

Also, a special medium-term credit program for purchase of materials was started in 1980, which is discounted by the BCT and requires BCT's approval of loans in excess of TD 5,000.

BNT's minimum loan for short-term credit is TD 500, and its criteria are based on the size of farm, type of crop and whether dryland or irrigated crop, and geographic location of farm (soils and rainfall). For cereals, the minimum area is around 40 hectares of dryland, with no stated minimum for irrigated land. However, it appears that most of its agricultural lending is to large-size farms. It was surprising to find that the cooperative production units received TD 3,300,000 of medium- and long-term credits in 1980 for purchase of equipment.

BNT supports two credit agencies which deal with small- and medium-size farms. One is an old program, the Local Mutual Credit Union (Caisse Locale de Credit Mutuelle, or CLCM); the other is a new program, the Mutual Security Society (Societe de Caution Mutuelle, or SCM). BNT supervises both these operations.

The SCM was created to lend to small- and medium-size farmers. The minimum size of cereal farms which it finances is around 10 hectares of dryland farming. Its operations in 1980 increased by 92.6 percent to TD 6,761,000. Credit was extended to 33,421 borrowers in 1979 and to 38,671 in 1980. The source of its financing is the Special Government Fund.^{63/}

In contrast to this, the operations of the Mutual Credit Union are declining. The number of these unions has declined from 45 with 77,000 members in 1971^{64/} to 16 with a membership of 28,959 in 1980.^{65/} The amount of annual lending has decreased from TD 4,539,373 in 1971^{66/} to TD 2,447,615 in 1980.^{67/}

USAID is now providing technical and financial assistance in a supervised credit program to small farmers (less than 50 hectares). This program was launched in the 1978 through 1979 crop year. It is called Assistance to Small and Medium Agriculturists of North-East Tunisia (Assistance aux Petits et Moyens Agriculteurs du Nord-Est de la Tunisie, or APMANE). This program is under the Ministry of Agriculture, not the BNT.

Judging from the performance records and visits which we made to a few farms receiving credit, the program appears to be making considerable progress. In 1980, APMANE made short-term loans to 4,000 farmers in the amount of TD 1,250,168. The accumulated total for

medium-term loans in 1980 was TD 600,950. In 1981/ 1982, APMANE opened lines of short-term credit to approximately 6,000 farmers in the amount of approximately TD 3,000,000 and increased medium-term loans to TD 830,505. Short-term credit is for supplies, labor, and machinery rental during the crop year. Medium-term credit is for the purchase of machinery and livestock.^{68/}

The program includes training of agents who work directly with farmers in developing farm budgets and in providing extension-type advice. A mixed farming system is being emphasized, based on production of cereals, forage crops, and grain legumes, together with a small number of livestock. Where well irrigation is feasible, this is being financed for vegetable and forage production and tree-crop cultivation.

Repayment performance has been good, considering that loans, both cash and in kind, are made to farmers who have never been eligible and have no experience with bank credit, and considering the record of such previous programs in Tunisia and elsewhere.^{69/} The reimbursement rate on short-term credit was 71 percent in 1980. It was expected to reach 80 percent in 1981.

The program is very popular with the Government of Tunisia and with the farmers served. While the cost of administering the program is large, it is probably not greater than other types of assistance projects. The training experience for the agents and farmers appears to be a sound social investment.

While the program is popular and attracting other donors for similar projects in other areas, the institutionalization of the lending operation would be better done under the National Bank of Tunisia. The technical assistance element is appropriate for the Ministry of Agriculture, but combining technical assistance with credit collection in the duties of an extension agent is not the best way to win farmers' confidence.

The records of one client of the program were examined. He has a farm of 16 hectares in the Grombalia area. This farm is divided into five separate parcels ranging from 2.0 to 3.5 hectares. The operator owns seven hectares and rents another nine hectares from another small farm owner. For the land he owns, the owner possesses a "Certificate of Possession," (not a deed). He owns five calves for fattening and 11 sheep

for wool and meat production. The farm production plan is illustrated in Appendix D, Table D-30.

A loan of TD 469 was provided in installments at the beginning of the crop year 1980 and extending throughout the entire crop year. The only cash loan was made for salaries for laborers for weed control and for harvesting. The rest of the loan was provided through purchase orders for services or materials. The cost of production was TD 729, including the cost of repaying the credit. The value of goods sold was TD 973, leaving TD 246 net operating profit (see Appendix D, Table D-30).

X. PERFORMANCE OF THE AGRICULTURE SECTOR (1970-1980)

Overall performance of the agriculture sector since the Wheat Development Program started in 1968 influenced performance of the cereal sector, both positively and negatively. On the one hand, the positive growth of the economy led to increased demand and stimulated production, but pricing and subsidy policies and investment orientation were competing factors, affecting cereal production negatively. Although cereal production increased significantly during the past decade over the previous one, more favorable policies could have caused greater increases. The limited parallel free market, mostly for durum wheat, provided incentives outside the official market. Also, the increased demand for other foods, particularly grain legumes, those fruits and vegetables that can be grown on dry land, and forage crops, helped cereal farmers. Cereal farmers, especially wheat farmers, cultivate other crops, some in rotation with wheat and some not. All wheat farms utilized less than 50 percent of their land in any one year for wheat, with some remaining in fallow and some in other crops (see Appendix D, Tables D-21 and D-23).

There was a major improvement in the performance of the agriculture sector during the period 1970 through 1979 over the previous period 1960 through 1970. The growth rate for agriculture rose from 2.0 percent per year during 1960 through 1970 ^{70/} to 5.1 percent per year during 1970 through 1979. ^{71/} This rate of growth is remarkable among developing nations, and is unusual even among middle-income countries.

The economy on a whole showed dramatic gains in the decade 1970 through 1980. The growth rate of Gross National Product (GNP) was 4.8 percent. Tunisia's economy advanced from the level of a developing country to that of a middle-income country. Per capita income

rose from a level of less than \$200 per year in the 1960s^{72/} to \$1,120 in 1979.^{73/} The inflation rate had risen, but not as greatly as in some European countries, showing a 3.7 percent annual rate in the period 1960 through 1970 and 7.5 percent during 1970 through 1979.^{74/}

Growth of the extraction industries, tourism, and receipts from emigrant workers abroad accounted for much of the economic gains. Petroleum and phosphate exports were major contributors. While agriculture did remarkably well, the industrial sector did better in relative terms. Domestic pricing policy, investment orientation, and marketing policy contributed to agriculture's decreased share of the Gross Domestic Product (GDP), but increases in income from petroleum, phosphate exports, and increased tourism were major factors decreasing agriculture's relative share.

In 1960, agriculture accounted for 24 percent of the GDP.^{75/} In 1979, it was 16 percent.^{76/} Agriculture provided 56 percent of employment in 1960^{77/} and 35 percent in 1979.^{78/} This reflects the rural exodus phenomenon as well as increased farm mechanization, which affected the Wheat Development Program, as described.

Gross domestic investment was 4.2 percent in 1960-1970 and 11.2 percent in 1977 through 1979.^{79/} Emphasis on investment in agriculture during the past two decades was in irrigation development, which brought 160,000 hectares of the 245,000 hectare potential under irrigation.^{80/} Some of the land formerly used for wheat production was used to grow vegetables, sugar beets, fruit, and forage crops, and to produce meat and milk. These higher valued cash crops were aimed at supplying the expanding State tourist industry in Tunisian resort hotels, in the export market (except meat and milk), and increased domestic demands, particularly in the urban areas.

As an example of the increases in irrigated crop production, sugar beets showed significant gains. In 1980, sugar beets were grown on 1,764 hectares, producing 62,121 metric tons annually,^{81/} expanding the operation of the refinery at Beja which had operated mostly on imported crude sugar during the 1960s. A second refinery is under construction in the Jendouba area for further expansion of the crop.

The Government's emphasis on irrigated crop and livestock production contributed more to satisfying increased

urban and tourist demand than improvement of the export market. Agricultural exports claimed 51 percent of the total value of exports in 1960^{82/} and 15 percent in 1979.^{83/} While this difference is largely due to the increased value of petroleum exports, the export trade for agriculture has not flourished. Exports of wine declined during the past decade, whereas the value and quantity of exports of olive oil, fruits, and vegetables increased. The percentage of total merchandise going to Europe and other industrial countries has declined. In 1960, 76 percent of merchandise exported went to industrial market economies as compared to 69 percent in 1979. Developing countries have received an increasing share, showing an 8 percent increase (19 percent in 1960 and 27 percent in 1979).^{84/} This trend is likely to continue, given the strong competition among southern European country members of the European Economic Community (EEC), the admission of Greece and Spain to the EEC, and EEC's regulations favoring its members.

Tunisia enjoys some climatic advantages for some fresh fruits and vegetables for off-season marketing in EEC countries during early winter when EEC regulations are more favorable to nonmembers. It has been able to expand this advantage by production of vegetables under 1,000 hectares of plastic.^{85/} Also, Government policy now aims at improving wine quality and increasing wine grape production for wine export.

The focus of investment on forages, grain legumes, and livestock has not necessarily been negative to cereal production, when this production is integrated with cereals in crop rotational patterns. This is feasible in higher rainfall areas. Integration of livestock production with cereal production, in general, offers a surer and better potential for farming in Tunisia. This is especially true for small- and medium-size farms. Given the current pricing structure and the incentive programs in subsidies which favor forage and livestock production including poultry, there are good possibilities of integrated cereal, forage and livestock production. This system is now being encouraged by the Ministry of Agriculture and the Office of Cereal's Technical Division. Tunisia is still an importer of livestock and dairy products.

The rise in per capita income in the urban areas has increased demand for high-value cash crops such as vegetables, livestock products, fish, pulses, and fruit, causing displacement of some traditional crops, such as cereals, in land use, particularly of the better land.

Vegetable crops were grown on 95,000 hectares of land in 1981 as compared to 81,000 hectares in 1977. Most of the production is on irrigated land. These crops have provided additional employment and income to rural people. In terms of total benefit to the country, this shift in investment has been responsible for much of Tunisia's agricultural growth. Table D-18 in Appendix D shows a comparison between 1962 and 1971 of the percentage contribution to the value added of agricultural, forestry, and fisheries activities (at constant prices). World Bank records show that the value added for cereals declined from 21.1 percent in 1962 to 14.1 percent in 1982. As a percentage of major crops, the value of cereal contribution was 30 percent during the period 1962-1971^{86/} and 24 percent from 1972-1980 at 1966 prices.^{87/}

The rise in incomes has improved private consumption, which rose from 3.2 percent per year during 1960 through 1970 to 8.2 percent per year during 1970 through 1979.^{88/} Per capita caloric intake rose from 2,234 per day in 1966 through 1968 to 2,698 per day in 1977 through 1979.^{89/} Population growth has also increased total consumption, but increased per capita incomes led to increased per capita consumption, contributing to total increased consumption.

The relative values of cereal production in terms of other crops do not accurately reflect its performance. The controlled prices are biased against cereals in this respect. Actual production showed significant gains from the adoption of the new technology of the Wheat Development Program. This was aided by increased mechanization, improvement in Government institutions, and other stimulating factors, including changes in public policies during the past decade, and general improvement of the economy. Increased encouragement to the private sector in the Government's policies of "coexistence of state, private, and cooperative sectors" is important to private cereal producers.

Table B-1 below illustrates the magnitude of the increase in production of cereals during the 11-year period 1971 through 1981 over the production during the 11-year period 1960 through 1970. The production figures were taken from Appendix D, Table D-4.

Table B-1. Production Increases and Average Annual Increases in Cereals Production, 1960 Through 1970 and 1971 Through 1981 (in 1,000 metric tons)

Cereal	Production 1960-1970 (11 Years)	Production 1971-1981 (11 Years)	Total Increase	Average Annual Increase
Durum Wheat	3,615	6,905	3,290	299
Bread Wheat	<u>899</u>	<u>1,746</u>	<u>847</u>	<u>77</u>
Total Wheat	4,514	8,651	4,137	376
Barley	<u>1,373</u>	<u>2,538</u>	<u>1,165</u>	<u>106</u>
Total Cereals	5,887	11,189	5,302	482

At 1981 constant Tunisian farm prices, (TD 96 for durum and TD 87 for bread wheat per metric ton; (see Appendix D, Table D-2), the value of the 4.137 million metric tons of additional wheat produced during the period 1971 through 1981 over the production during the period 1960 through 1970 would be TD 389,530,000, or U.S. \$700,467,000 (U.S. \$1 = TD 0.5561, 1982 exchange rate; (see Appendix D, Table D-31). This additional wheat production consisted of 3.290 million metric tons of durum wheat at TD 315,840,000 (U.S. \$567,955,000) and 847,000 metric tons of bread wheat at TD 73,689,000, (U.S. \$132,510,000). Additional barley production of 1,165,000 metric tons would be valued at TD 80,385,000 (at TD 69 for barley per metric ton), or U.S. \$144,551,000. Therefore, the additional cereal production of 5.302 million metric tons for the period 1971 through 1981 over the period 1960 through 1970 would be valued at TD 469,914,000, or U.S. \$845,017,000 (see Appendix D, Table D-31) at 1981 constant farm prices and 1982 constant exchange rate (the actual exchange rate during the two periods fluctuated around 0.500 TD for U.S. \$1).

Using the statistics in Table B-1 and figures shown above (1981 prices), the average annual additional production of 299,000 metric tons of durum during 1971 through 1981 would be valued at TD 28,704,000 (U.S. \$51,616,000); the average annual additional production of 77,000 metric tons of bread wheat would be valued at TD

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6,699,000 (U.S. \$12,046,000); and the 106,000 metric tons of additional barley would be TD valued at TD 7,314,000 (U.S. \$13,152,000). This would bring the total average annual value for the additional amount of the three cereals to TD 42,717,000, or U.S. \$76,815,000 per year to the Tunisian economy during each year 1971 through 1981 above that during the period 1960 through 1970 (at 1981 constant prices and 1982 constant exchange rate).*

The potential annual savings to the Tunisian Government in foreign exchange costs of importing this equivalent additional amount of cereals annually, if there had not been an increase in production during 1971 through 1981, would have been staggering. Durum wheat in February 1981 was priced at \$307 per metric ton imported to Rotterdam (c.i.f.) from the United States. Bread wheat (No. 2 soft red winter wheat) from the United States was priced at \$215 per metric ton and barley at \$166 per metric ton (estimated). The import cost of 299,000 metric tons of durum wheat in Rotterdam in 1981 would have been U.S. \$91,793,000. Tunisia would have paid a slightly higher price because of longer haulage. The additional 77,000 metric tons of bread wheat, if not produced domestically each year, would have cost Tunisia annually U.S. \$16,555,000 (plus) to import; and the 106,000 metric tons of barley would have cost U.S. \$17,596,000 (plus) to import, using 1981 constant prices and 1982 constant exchange rate.

Thus for a foreign aid investment of less than \$3.5 million, AID, CIMMYT, and the Ford and Rockefeller Foundations have contributed to increased production of cereals which resulted in decreased imports, valued annually at U.S. \$125,944,000 in foreign exchange costs (1981 prices and 1982 rate of exchange).^{90/}

A comparison of per capita cereal production between the two periods (1960 through 1970 and 1971 through 1981) also shows positive gains. In 1970, the Tunisian population was 5,127,000, and in 1980 it was 6,363,000.^{91/} Average annual production of wheat in 1960 through 1970 was 411,000 metric tons and in 1971 through 1981 it was 787,000 metric tons. For total cereals, average annual production was 535,000 metric tons and 1,017,000 metric tons for the two periods, respectively. Per capita annual production of wheat increased from 70 kilograms in 1970 to 124 kilograms in

*U.S. dollar conversions are rounded.

1980. For total cereals, the per capita annual production in 1970 was 104 kilograms and in 1980 it was 160 kilograms, also reflecting a substantial increase in productivity.

Although self-sufficiency in cereal production has not been reached, more Tunisians are eating more cereals. Per capita annual consumption had increased from 44 kilograms of bread wheat and 89 kilograms of durum wheat in 1966^{92/} to 87 kilograms of bread wheat and 90 kilograms of durum wheat in 1974 (based on a 1975 survey).^{93/} Consumption of cereals was unofficially reported to be higher in 1980. Population growth and increased per capita income (from tourism, petroleum and mineral exports, and improvements in the agricultural sector) have increased demand. Increased urbanization and monetization of the traditional agricultural sector have changed consumption patterns, shifting them to greater consumption of commercially baked bread and noodles, and new consumption of less traditional home-made foods.

While reaching self-sufficiency has remained an unattainable target, economic benefits from increased production resulting from the Wheat Development Program have been great. Additional cereal production has stimulated and created a great number of other economic activities. While it is not possible to quantify these, the additional employment and economic activity generated by the addition to the economy of 482,000 metric tons of cereals in a year would be significant. The movement of this quantity of a commodity through the process from farm to consumer has a multiplier effect on increased economic activity. Also, the movement of the money representing the value of this commodity likewise generates additional economic activity.

Despite these significant gains, Tunisia is still in deficit in cereals, having to continue to import cereals to meet consumption needs (see Appendix D, Table D-32). Population growth and increased per capita consumption continue to widen the gap. The gap increased from 301,000 metric tons in 1976 to 628,000 metric tons in 1980. The potential exists for much greater increases in production of cereals if adequate amounts of fertilizers, herbicides, and insecticides are imported, and the distribution system is expanded and managed to satisfy the demand. This must be accompanied by increased credit availability and by a rational pricing system that shifts more of the bias from the industrial sector (bread subsidization) to cereal farmers in order

to stimulate greater investment and production. This issue is critical in view of the anticipated decrease in petroleum in about 10 years when Tunisia is expected to become a net oil importer. It appears that policy makers are thinking in this direction.

The goal in Tunisia of self-sufficiency in cereal production has been illusory and has tended to overshadow progress that has been made. Population growth and increased per capita income have increased food consumption, widening the food gap despite significant increases in total production, yields per hectare, and production per capita. Also, while other economic goals of maximizing the comparative advantage in agricultural production by growing higher valued crops for export and tourism on better lands under irrigation, and achieving a balance in trade of agricultural products tend to be competitive with cereal production goals, these other goals make good economic sense.

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FOOTNOTES

- 1/ William F. Johnson, "Agricultural Sector Paper," Annex to Agricultural Development Loan Paper, Fiscal Year 1972, USAID, February 18, 1972, Table 17.
- 2/ Ibid, p. 42.
- 3/ Centro International de Majoriamiento de Maize Y Trigo, established by the Rockefeller Foundation.
- 4/ Harold D. Nelson, Tunisia--A Country Study, Foreign Area Studies, the American University, Washington, D.C., 1979.
- 5/ Information provided by Allala Godbane, Chief, Technology Division, Office of Cereals, Tunis. The station was the forerunner of the current Tunisian agricultural research station, Institut National du Recherche Agronomique de Tunisie.
- 6/ Nelson, op.cit., p. 53.
- 7/ Ibid, pp. 139-140.
- 8/ Ibid, p. 71.
- 9/ Ibid, p. 139.
- 10/ Godbane, op.cit.
- 11/ Johnson, op.cit., "Agriculture Sector Paper."
- 12/ J. D. Hyslop and R.P. Dahl, Wheat Production in Tunisia -- Trends, Variabilities and Prospects, University of Minnesota, Republic of Tunisia, Under Secretary of State for Agriculture, September 1968.
- 13/ Herman Van Wersch and Thomas Davis, Retrospective of Tunisian Agriculture: 1962-1971, International Agricultural Series 13, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota, 1972.
- 14/ M. Yudelman, "Follow-up Report on Tunisian Agriculture," report done for USAID/Tunisia, September 7, 1965.

Habous was a trust arrangement where the church or individuals held private land for religious, philanthropic, or private estate purposes.

- 15/ Nelson, pp. 51-52.
- 16/ Johnson, op.cit., "Agricultural Sector Paper," p. 85.
- 17/ Ibid.
- 18/ Ibid.
- 19/ Ibid.
- 20/ Christopher Mock, "The Tunisian Cereal Distribution and Milling System, Case Study: Tunisia," from Global Malnutrition and Cereal Fortification, James Austin, ed., Ballinger Publishing Company, Cambridge, Massachusetts, 1979.
- 21/ Ibid, p. 45.
- 22/ Richard Newberg, "Multi-year Proposal Program Paper --Tunisia, PL 480, Title I," USAID/Tunis, March 1981.
- 23/ Johnson, op.cit., "Agriculture Sector Paper."
- 24/ Food and Agriculture Organization, Rapport National de la Tunisie, No. 8, Conference Mondiale sur la Reforme Agraire et le Developement Rural, Rome 1979, pp. 92-93.
- 25/ Salem Gafsi, Green Revolution: The Tunisian Experience, abridged and published by CIMMYT, Mexico 6 D.F., 1976. This version was abridged from Gafsi's Ph.D. dissertation at the University of Minnesota.
- 26/ Ibid.
- 27/ Bureau of Planning, Statistics, and Economic Analysis, Ministry of Agriculture.
- 28/ Mohamed Ben Senia, "Supply Response of Cereals in Tunisia," abstract of Ph.D. thesis, Iowa State University, Ames, Iowa, 1981.
- 29/ "Report of Subcommittee for Major Field Crops for the Ministry of Agriculture, 1980," and "Report of Evaluation of Achievements in the Agricultural Sector, 1970-1979," Ministry of Agriculture.

- 30/ Ibid.
- 31/ Ben Senia, op.cit.
- 32/ Gafsi, op. cit.
- 33/ Ben Senia, op. cit.
- 34/ Ibid.
- 35/ Ibid.
- 36/ D.G. Dalrymple, Development and Spread of High-Yield Varieties of Wheat and Rice in the Less Developed Countries, Foreign Agriculture Economic Report No. 95, Sixth Edition, USDA, Washington, D.C., 1978.
- 37/ Ibid.
- 38/ Malcolm J. Purvis, "The New Varieties Under Dryland Conditions: Mexican Wheat in Tunisia," American Journal of Agricultural Economics, February 1973.
- 39/ Information provided by Dr. W. McCuistion, a plant geneticist who served with the Wheat Development Project in Tunisia and is now a member of the faculty of Oregon State University.
- 40/ Ibid.
- 41/ Purvis, op.cit.
- 42/ Terry Roe and David Nygaard, Wheat Allocative Error and Risk: Northern Tunisia, Bulletin V, Economic Development Center, Department of Economics, Minneapolis, Department of Agriculture and Applied Economics, University of Minnesota, St. Paul, Minnesota, March 1980.
- 43/ David Fergus Nygaard, "Risk and Allocative Errors due to Imperfect Information: The Impact on Wheat Technology in Tunisia," Ph.D. thesis submitted to the Graduate School, University of Minnesota, December 1979.
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APPENDIX C
SOCIAL IMPLICATIONS OF THE WHEAT DEVELOPMENT PROGRAM
(PROJET BLE)
FOR THE IMPACT EVALUATION

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I. INTRODUCTION

This appendix on the sociological setting and impact of the cereals production program in Tunisia has three major parts: Section II, Preproject Social Setting, 1955 through 1966; Section III, Social Setting During the Project, 1967 through 1975; and Section IV, Social Setting After the Project, 1975 through 1980. In each of these sections we have attempted to center our analysis essentially on changes in land tenure and agricultural labor and consumption patterns. This division will enable us to view the evolution not only of the project, but also of the social changes in the project area and the nation in general, for the impacts certainly were not confined only to the project area of northern Tunisia. A summary of the entire analysis with an attempt to define sociological lessons learned from that entire evolution will conclude our report.

II. PREPROJECT SOCIAL SETTING, 1956-1966

A. Sociohistorical Background

Prior to independence in 1956, Tunisia's cereal farmers were clearly divided between those who grew durum wheat for their consumption and those who grew it for export. That distinction was based essentially on the needs of each group. The former were the small farmers and couscous consumers, who were the majority of Tunisians. The latter were the French colons, who grew wheat for their own consumption of bread, for urban needs for bread, and for export of durum wheat to France. Those farmers who grew durum for their own consumption were mostly small farmers who had been pushed by economic and social factors into arid areas and the more rugged farmland. The wheat growers for export farmed on better land in temperate climate with more favorable rainfall and better access to urban centers.

An understanding of this historical situation is important, for it has had a great and irreversible impact on the evolution of the farming systems of the country, and in particular of the northern region with which the Wheat Development Program is most concerned. It also helps to explain the social conditions which prevailed and persist and the important impact of the land reform attempt in the late 1960s which affected land ownership at all levels.

Very little information exists on the social profile of the northern region in the 1960s. However, the data from various surveys and agronomic reports of the decade provide information on the general standards of living in the country and in the region, and on the production outputs. This gives us a bird's-eye view enabling us to comprehend and appreciate the enormous changes that took place after 1956, and especially after 1966, at the initial design stage of the project.

The goals set for the project fit within the overall goals of the 10-year planning perspectives of 1962 through 1971 of the Government of Tunisia (GOT). These could be considered of purely economic and agronomic interest, as can be noted in the outlined goals of the projects. Yet, their social implications are great and, undeniably, impacted significantly on the society as a whole, and on farmers in particular.

The overriding goal since the early years of independence, and still of primary importance for Tunisia in the 1980s, is food self-sufficiency. This is true in spite of the fact that between 1959 and 1961, 22 percent of all agricultural produce was exported, helping offset through its foreign exchange earnings about half of the foreign exchange deficit generated in other sectors. But these figures were not reflected in the well-being of the society. In 1961, 73 percent of the population was below the poverty line, with a per capita income of less than 50 Tunisian dinars (TD--about \$90) per year. The level of poverty has greatly declined in the past 30 years, especially in the rural areas (inflation has raised the poverty line to TD 100-120 today). Yet, in a country theoretically considered at the middle-income level, the figure cited in 1975 for the poverty level of 37 percent of the population (plus 17 percent living in "absolute poverty"^{1/}), cannot but raise great concern for planners and donors alike. Indeed it is noted that one out of every six Tunisians was living in absolute poverty in 1980.^{2/}

Because of incomplete data, especially for the early years after independence, Table D-33 of social indicators for 1959 through 1966 (see also Appendix D, Table D-35) does not allow a complete statistical social comparison between the two periods of 1959 and 1966. It does indicate, however, the progress made in the general improvement in health, education, and land distribution.

B. Changes in Farming Systems and the Project

The agrarian reform policy, begun in 1962 with the aim of redistributing and cooperatizing land, had a great impact on the rural population, in particular in the northern region. At the time of independence, there were 4,700 foreign farm owners with a total of over 700,000 hectares, while "modern" Tunisian farmers owned a total of 400,000 hectares (of which 150,000 were for cereal production), and 450,000 small farmers each had an average of 7 hectares or a total of 3,500,000 hectares.^{3/} That is, 1.2 percent of owners were foreigners who owned two-thirds of the best arable land. The traditional Tunisian farmers had been pushed to the hillsides and arid lands.^{4/}

These figures highlight two important social factors: (1) a majority of Tunisian farmers grew subsistence crops, had no access to production resources, and had limited technological know how, and were consequently unprepared for modern production, management, and technology; and (2) the departing foreigners took with them virtually all technical and managerial skills, creating a gap in overall production.

The objectives set in the 1962 through 1971 development projections were all to be achieved through the extensive modernization of the agricultural sector and its interaction with other sectors, as well as through the use of extensive mechanization. State and farm cooperatives were to be the channeling force for these changes. Some of the large colon farms became the core of the state production cooperative farms while the small private holdings were grouped into Cooperative Production Units (UPC). By August 1969, one-third of all arable land had been cooperatized. Such a reorganization took little consideration of local conditions and incentives. Moreover, the lack of management and technological skills created great inefficiencies which were exacerbated by the great number of members within each cooperative. A dramatic situation ensued that led to a reorientation to private control of land. This took place in September 1969, leading to a rapid desertion of cooperative farming by former private owners (a decline in cooperatized land of 66 percent occurred in the first year).^{5/} Yet, large owners profited from the changeover for they were able to reinstate themselves financially on their land while many small farmers were forced to rent or sell out their land to larger owners or remain in cooperative units.

Such was the institutional, agricultural, and social picture at the start of the Wheat Development Program. It is extremely interesting to note, however, that none of the early documents of the project showed any indications whatsoever that social interests were taken into account. The complete lack of concern for the socioeconomic conditions prevailing in the project area persisted throughout the project, except for academic research in the late 1970s and early 1980s by Tunisians and Americans (Gafsi, Ben Senia, Roe, Nygaard), which included some data on farmers' acceptance levels and adoption of high-yielding wheat varieties. No such data existed elsewhere. In one project document only (Meinecke) can social concerns be inferred from targets secondary to the project: (1) the need for self-help programs, and (2) the suggestion of population planning. This lack was due essentially to the way projects were then designed and implemented and because the national goal and that of the project were entirely centered on production increases. And yet, agronomic concerns were noted at the early stages of the project that could have been closely linked to social and economic conditions.

C. Technological Constraints and Agricultural Labor

A number of agronomic constraints, or at least potential problems, that were noted at the start of the project, had both social and economic implications. Most of these were linked to the importance of a functional and adequate extension system. This most immediate link between farmers and research institutions, and one of the important components of the success of any agricultural project, is the weakest link in many underdeveloped countries. These constraints could be summarized as follows:

- The importance of a control mechanism (i.e., management and decision-making) for the farmer in all cultivation stages--seed preparation, seeding dates, date of planting, amounts and timing of fertilizer, weed control, etc. These various sets of controls implied not only a change in the cultural practices of farmers but also in their understanding of the need for such changes and control. This requires mutual exchanges between farmer and extension worker, but especially an ability on the part of the latter to understand the former.

- The introduction of a package technology for the cultivation of new wheat varieties. This ideal package concept implied a farming operation under optimum resource combinations with profit-seeking goals. What the farmers were or were not able to do was not considered at the outset.6/
- Availability of input equipment and credit as well as favorable prices for produce are probably the greatest limiting factors to date, greatly diminishing the incentives of the small, if not also the medium, farmer and having both social and economic repercussions.
- The importance of adaptation of the new varieties to local tastes and quality standards had not been considered, though this has profound social and consumption implications as will be noted later in this discussion.
- The importance of the availability of family labor and/or machinery or the ability to substitute one for the other was a consideration of social and economic significance for all the farmers and especially the small farmers. This constraint was potentially significant because the social organization of labor and production was beginning to acquire different characteristics on the eve of the project. This was due to two important legislative actions: (1) in 1957, polygamy was officially forbidden, eventually limiting family labor; and (2) by the 1960s, labor force emigration was an accepted official policy.

To this should also be added the massive departure from Tunisia, by the late 1960s, of some 70,000 foreign male workers and 20,000 foreign female workers whose positions had to be replaced by Tunisian males and, to some extent, females.

The female labor force has increased by 5.5 percent annually since 1957, allowing women to enter the nonagricultural sector but also creating a growing lack of incentive for them to remain as family aids in agricultural labor, previously their only possible labor opportunity. A rapid increase in educational opportunities for females also occurred in the same period.

Emigration policy encouraged a rural exodus and an increase in the urban population. It is noted that by 1966, 36 percent of all people living in the Tunis governorate had come from another region.^{7/} International emigration, though still small, had greatly increased between 1962 and 1966, and had reached over 200,000 persons by 1972 (more than double the number in 1962). Of these, 55 percent were between the ages of 20 and 29, and 28 percent between the ages of 30 and 39.^{8/} This emigration of young men and adults was mainly directed to France, Germany, and Libya, and in many cases toward employment in the agriculture sector. Meanwhile, however, the percentage of agricultural labor in Tunisia had diminished by almost 19 percent between 1959 and 1966 (see Table D-33 in Appendix D). All these factors created a very distinct trend toward an older agricultural labor force, especially among the males. In 1966, the high ratio of male participation in the total labor force (83 percent) versus female participation in the labor force (26.3 percent) confirmed the higher percentage of the elderly in the agricultural labor force, for while employees of Government and businesses have a compulsory retirement age, this is not the case for agricultural labor. Indeed, the 1966 census indicated that only 53,000 males (out of a population of 4,533,351) who had reached retirement age had actually retired, or the equivalent of 4.3 percent of males of working age.^{9/}

Total agricultural production began to decline in the mid-sixties because of the decline in the agricultural labor force, the changes in the land tenure system, and the bad weather conditions. Until then, Tunisia had been self-sufficient in durum wheat, though it imported most of its bread wheat. As a result, by the mid-sixties, it had to import both. This had an undeniable impact on the nutrition and consumption patterns in the country, for wheat is the leading food commodity in Tunisia and the principal source of calories and protein. Meanwhile, from the start of independence talks until the expropriation of their land in 1964, the French had been cultivating their lands very extensively, exploiting the land as though it were a mine.^{10/} This led to the rapid exhaustion of the soils in less than a decade.

D. Consumption and Nutrition

In 1968, a Comité Sectoriel de la Nutrition et de la Planification Alimentaire (Sector Committee of Nutrition

and Food Planning) had estimated the nutritional levels in Tunisia and had projected a mild increase in per capita demand by 1980 for total cereals consumption from 147 kilograms per capita per annum in 1968 to 149.94 kilograms per capita per annum in 1980.^{11/} While the average per capita daily intake in the mid-sixties was estimated to be 2,340 calories (rural, 2,250; urban 2,600), the FAO estimate for 1964 and 1966 was 2,126 calories daily per capita intake. In any case, the proportion of the population receiving less than the minimum nutrient levels was considered "alarmingly high," ranging from 25 to 61 percent for the country as a whole, and 30 to 70 percent for the rural population. The study showed deficiencies in all levels of vitamins except for the B vitamins.

It is significant to realize the importance of the nutritional supply of cereals because of the latter's predominance in the national diet, both urban and rural. In 1968, cereals accounted for 56 percent of total caloric intake, 67 percent of protein, 80 percent of vitamin B₁, 52 percent of vitamin B₂, and 30 percent of calcium.

In 1968, cereals also accounted for 16 percent of total household per capita expenditures per annum and 35 percent of per capita food expenditures^{12/} while total food expenditures were 50.3 percent of the total household budget. Indeed, a World Bank report notes that in the poverty-level households, per capita food expenditures per annum were 61 percent of the total household budget.^{13/}

If the pattern of food expenditures was found to vary geographically (urban, 26.5 percent and rural, 32.8 percent of per capita total annual household expenditures), food consumption patterns also varied according to the urban and rural setting, highlighting distinctions in food varieties and nutrient potentials. In the rural setting, food expenditures were concentrated on cereals, oil, fat, tea, coffee, sugar, and fruits; in the urban areas, on meat, vegetables, milk, dairy products, spices, root crops, beans, fish, and eggs. It is also interesting to note the differences in consumption patterns among cereals, especially between bread wheat and durum wheat. Table C-1, from the Consumption Survey of 1968, highlights the great differences between the rural and urban patterns. The rural population consumed 68 percent of durum versus 17.9 percent of bread wheat while the reverse occurred in the urban

centers: 76 percent of bread wheat versus 23 percent of durum. This also confirms the great importance of durum--the basic ingredient for couscous meals--in the national diet, which still persists today.

Table C-1. Distribution of Cereals Consumed Per Capita Per Annum (in Kilograms) 1965-1968				
Cereals	Big Cities	Urban Areas	Rural Areas	Average
Durum	30	80	114	89
Bread Wheat	98	40	30	44
Barley	--	9	22	14
Other	<u>1</u>	<u>1</u>	<u>1</u>	<u>--</u>
Total	129	130	167	147

Source: Enquete Nationale sur le Budget et la Consommation des Menages en Tunisie, 1965-68,
Ministere du Plan, Tunis, 1968, p. 160.

Economic factors may not always be the main reason for poor nutrition, but incomes considerably affect caloric intakes.^{14/} In Tunisia in the mid-sixties, the following factors added to continuing poor rural nutrition and consumption patterns:

- Climate-limiting variety of produce cultivated;
- Limited distribution centers for agricultural produce;
- Inadequate transportation facilities;
- Inadequate home storage facilities;
- High rate of migration to urban areas;
- Need for cash to allow for better nutrition or, at least, a varied diet;
- Subsidization of bread cereals which may have increased bread consumption of the poor, but did not provide a nutritionally satisfactory substitute for main foods;

--Difficulty of making rapid social change especially in consumption habits, such as acquisition of new tastes.

Very slight differences exist between the nutritional levels of the untransformed local and the high-yielding varieties of bread wheat introduced in Tunisia.^{15/} Therefore, what is significant is the level of consumer acceptance between the two and the nutritional level of the transformed product. These factors were not as yet known in Tunisia in 1968. Figures D-6 and D-7 in Appendix D on cereal consumption and caloric intake in 1968 indicate, however, the extent of and differences in both factors. They also give us an understanding of the relationship between cereal consumption and total caloric intake. It should be kept in mind that the cereal consumed was essentially durum in the form of couscous and traditional whole wheat bread. We can, therefore, note that where caloric intake is the highest, durum consumption is also high. (See maps, Figures D-6 and D-7 in Appendix D).

III. SOCIAL SETTING DURING THE PROJECT, 1967-1975

A. Early Years of Project and Impact on Farmers

When the Accelerated Cereals Production Project began its first campaign in 1968/1969, it was faced with an unanticipated sociopolitical situation.

The sudden change to land collectivization in the early sixties changed again as suddenly in September 1969, and did not give the project personnel time to assess the meaning of the changes or their impact on research and "outreach" efforts. Policy orientations turned abruptly from general collectivism to restricted collective farms, private initiative and investments, and productive industrial development. The cooperative movement proved incapable of dealing with credit, management, technological requirements, distribution systems, and most of all, it lacked incentives.

The "terres domaniales" were kept as large State farms with the goal of intensive mechanization through extensive farming, and relatively few small cooperatives (UCP) were maintained, while large amounts of formerly private land were reinstated to their former owners. It was not difficult for large owners to repurchase and reinstate themselves on their lands for they not only

had the financial means and the available labor but also the necessary machinery and credit opportunities to pursue intensive cereals production. The small farmers were unable to reinstate themselves under "normal" conditions, lacking the means to repurchase their lands or any sort of equipment or credit. Many had no choice but to remain in the cooperatives or to rent out or sell their land parcels to larger owners.

At the start of its first campaign in 1968/1969, the project therefore found itself faced not only with nearly insurmountable institutional problems but also a series of cooperative systems in disarray. Moreover, the climatic conditions that year included a severe drought; soils, overused as a result of the failure of the departing French colons to respect traditional rotational systems, were devastated even in the richest areas; and rural exodus and unemployment were extremely high.

The project nevertheless started with a high level of enthusiasm, with its most important goal, that of introducing high-yielding varieties of bread wheats and providing opportunities for higher overall cereals production. However, it found itself confronted with important agronomic, institutional, social, and economic constraints:

- Soil degradation beginning with the early years of independence;
- Irregular rainfall, and the start of the drought in 1968;
- Lack of research and extension personnel (while training was one of the project goals, the personnel needed for the early years of the project had not yet returned from training);
- Old age of agricultural population because of increasing rural exodus;
- Parcelling of arable land;
- Lack of means and know-how of a large proportion of farmers to use "package technology";
- Irregular distribution of credit; and

--Greater consumption by the farmers themselves of durum wheat, and therefore greater resistance to cultivation of bread wheat.

The parcelling of arable land was certainly the most serious (and still persisting) constraint to agricultural development. If large farmers, and perhaps also the medium farmers, had the necessary acreage to utilize machinery to its optimum capacity, they would be able to amortize their expenditures through higher yields. The small farmer, one with up to 30 or 50 hectares, had two to four, or even more noncontiguous parcels, which increased labor time and use of machinery. This also led to increasing tractor use and decreasing production efficiency. (It should be noted that 30 to 50 hectares of rainfed land are equivalent to 5 hectares of irrigated land.) Eighty percent of all private farmers had less--and still have less--than 20 hectares of land.

Policy-makers and project designers had, as an initial goal, food self-sufficiency through the introduction of high-yielding varieties of bread wheat together with an essential technological package. However, they had not calculated the economic or institutional capacity of the country to sustain such a program, nor did they consider how the traditional farmers, with the subsistence logic of seeking continuity and thus reliability of production rather than entrepreneurial profitability and its consequent risks, would pass from a subsistence form of production to the requirements of new technology. Again, it should be emphasized that this was a period when it was thought that radical agrarian change was the solution to all problems of production. In no way was it the intent of either the project or the policy-makers to develop speculative cereal production. Yet a combined series of factors--lack of distribution of agricultural inputs, unequal distribution of land, inequitable credit systems, difficulty of applying the technological package, etc.--very quickly led to that situation from the outset.

The first campaigns of the project, in 1968 to 1972, had one overwhelming impact: all farmers, large and small, became aware of the existence of high-yielding varieties. Even though bread wheat varieties did not have as large a success as durum varieties, when high-yielding varieties of the latter began to be distributed in the early 1970s, their acceptance was immediate and widespread. In 1968, 700,000 hectares of

durum wheat were cultivated versus 133,000 in bread wheat. In 1972, 862,000 hectares were cultivated in durum versus 260,000 in bread wheat. The latter never exceeded the 275,000 hectares planted in 1973 (in 1981 it was down to 94,300 hectares); durum wheat reached a high level in 1976 of 930,000 hectares, and was at 821,700 hectares in 1981. In 1976/1977, the percentage of high-yielding variety in durum cultivation was 26.5 percent, reaching 36.4 percent in 1979/1980 (INRAT 69 variety).^{16/} This indicates the extent to which the concept of change had its impact on all farmers, and was particularly important among the small farmers who produced durum for their own consumption. This impact is profoundly significant for it should be recalled that it even influenced the older generation, those most resistant to change: farmers whose average age was over 50 years.

A synopsis of the first four campaigns of the project, based on a survey undertaken in 1974,^{17/} will give a general understanding of the evolution, problems, and successes of the project, as well as the national policy changes that took place and which played a role in the farmers' overall capacity to adjust to the changes.

The first campaign, 1968/1969, was essentially directed to large farms (then the State farms and a few private owners) which had adequate means of production. In spite of bad weather, the harvest in high-yielding varieties of bread wheat was higher than in traditional varieties. The project personnel had noted that those with low harvests had not followed the instructions given, generally because of the low technical understanding of the farmer. It was the first realization of how the farmer was functioning, his means and his level of awareness of new techniques. It is interesting to realize that the technical problems, raised then, persist today: lack of weed control, lack of fertilizer use, and lack of understanding of the method of seeding.

The second campaign, 1969/1970 was directed to small and medium farmers. In spite of the repercussions of the drought and of the reversal, between August and September 1969, of the land reform policy from collective to private ownership, the results of the campaign still appeared positive. It was noted, however, that those with high yields had large land areas, better soils, and greater means, a point also raised in a later report by a CIMMYT team on prevailing conditions in 1977.

That particular campaign raised several logistical problems which allowed policy-makers to realize the extent of the problems and attempt to resolve them. The most crucial bottlenecks were, in essence, all due to institutional and management constraints: storage, input distribution, extension, and credit facilities.

It was during that campaign that farmers were given seed on credit.^{18/} It will be recalled that during that year the small farmers, in particular, had no means of production, having lost membership in the cooperatives, and had no seed to plant their lands. They welcomed whatever seeds were made available to them.

The third campaign, 1970/1971, had the goal of increasing the acreage of cultivation of high-yielding varieties of bread wheat. This meant that more small farmers were contacted. The results of the campaign were very negative, for seeds given to the farmers were of poor quality, which particularly affected small farmers. Yields of high-yielding varieties were half those of traditional varieties. Greater socioeconomic problems were also highlighted by this campaign, showing the gap of possibilities between small and large farmers, eventually impacting on overall production and on credit repayments:

--Of the farmers who obtained credit, 2,700 (with a total of 700,000 hectares) had the best lands and the largest farms. Their credit rose from TD 12 to TD 20 per hectare, covering 30 to 40 percent of their expenditures.

--The small farmers, those with less than 100 hectares, had no means of acquiring credit. Seeds were obtained from the Cereals Board, but these were in the form of a subsidy rather than credit. Thus, farmers could not cover expenses.

Though attempts were made during this campaign to contact small farmers and make credit available to them, the devastating results of the campaign made any repayments by small farmers impossible. Moreover, it caused a dramatic decline in the adoption of new varieties the following year,^{19/} as did the redefined credit policy.

The unfortunate distribution of bad seed was probably a determining factor, together with the added logistical problems involved, in slowing down the project. This occurred despite the now widespread

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awareness of the varieties and the immense efforts made by all project personnel whose popularity and dynamic personality were crucial factors to both the inception and growth of the project. It is extremely pertinent to point out that by the third campaign, a new image of the technicians' role existed with the Tunisian institutions. Their changing perception also had an important and irreversible impact on the farmers' appreciation of the role of the technician and extension worker.

It is said that the dynamism of the project had created a sense of competition among the extension workers (most of whom had high school-level training or less) over who would make the greatest number of contacts and distribute the most seeds. This, however, had a counterproductive impact on the cereals production effort as a whole, for neither was infrastructure support adequate to make available credit and fertilizers for small farmers, nor were extension workers sufficient in number to adequately monitor and give advice to the farmers.

By the fourth campaign, 1971/1972, a need was perceived to redefine the project goal. Whether because of all the above factors or the new internal directives of USAID or both, is ultimately not as important as the realization of the need to narrow the objective from national self-sufficiency in cereals production to include training and institutional support aspects as being essential to production goals. This change of direction also coincided with a change in policy on credit and on the technical aspects of the project, which had a general impact on farmers.

Stricter rules were set for cultivators and farm conditions (beginning with 10 hectares), and eligibility for credit (those with debts were ruled out and initial payments of 25 percent were required). This may have decreased the number of farmers, but it also began the move towards efficiency, control, and better balance between farmers and extension workers whose number and qualifications have never been sufficient to meet the needs of farmers.

During these four campaigns, and even later, small farmers who received seeds were not always using them for cultivation. Their economic situation was such that many preferred to use them for immediate consumption or, better still, to sell them. A black market developed in seeds of high-yielding variety.

Several conclusions of social significance can be derived from these early campaigns:

- The production goal, which required a package technology, could not be adopted except by a minority of farmers who had the means and the space to adjust to it.
- The extensive use of mechanization increased already rampant unemployment and rural exodus and created an added burden on the project mechanism: lack of spare parts and repair facilities. It also added a heavier economic burden on all farmers, especially those with less than 100 hectares, at a time when bad weather, land reform, and credit changes were also occurring.
- The single goal of encouraging wheat production did not encourage crop diversification or cattle raising among small farmers who needed such diversity to maintain economic equilibrium.
- The success of high-yielding varieties in the early years was due to the fact that they were cultivated on the best arable land where the big farms still existed. A generalized and indiscriminating use of the seeds proved unfeasible.
- The multitude of changes which took place during these early years, particularly the combination of land reform and wheat production goals, led many farmers to rent out or sell their land, often becoming laborers on their own land; this also gradually increased the ability of large farmers and some medium farmers to extend their acreage.
- The technical problems attributed to the difficulties of production were real--lack of weed control, lack of use of fertilizer, etc. But they were due to socioeconomic conditions which affected the level of ability to adapt to the new technology.
- The bread wheats introduced were not adapted to the consumption needs of the majority (see discussion on impact on consumption below) which led to two situations: (a) increased

monetization needs of farmers to buy wheat couscous for consumption at a time when unemployment was increasing; and (b) increased consumption of French bread at the expense of a more complete meal, exacerbating already low nutritional levels.

- The most positive impact of the project was that it helped to catalyze the acceptance of change among all farmers, small and large.
- An irreversible change took place in the type of relationships established between extension worker and farmer to one that was previously unknown in Tunisia.
- The farmers' own incentives had increased but institutional support was incapable of meeting their needs.

B. Criteria for Farmers' Acceptance of High-Yielding Varieties

Three important studies were made in 1975, 1979, and 1980, all dealing with farmers' perceived and actual adoption, economically and technologically, of the high-yielding varieties introduced.^{20/} Together, all three reports span the years of the project, and at the risk of repeating some of the conclusions drawn above, it is pertinent here to highlight their own conclusions based on the significant factors of attitudes of risk and levels of adaptability of the northern Tunisian farmers within the project area.

Thus, these particular studies, all written after the effective completion of the project, explain the development of the pattern of adaptation to highyielding varieties. It does not appear, however, that they were ever brought to the attention of policy-makers even though their analysis and conclusions would be of great value today in the refinement of policy for cereals production, (along with another doctoral thesis).^{21/}

All three studies seem to corroborate on another in their conclusions, particularly in their delineation of the socioeconomic determinants of the farmers' adoption of the high-yielding varieties. A profile of the characteristics of the farmer most likely to effectively use these varieties and their required technology include the following:^{22/}

- The average farmer's age is 50.8 years;
- He has an average farming experience of 28.5 years, with literacy not being a determining factor except as it affects the extent to which high-yielding varieties of bread wheat are used;
- His land averages 67.7 hectares, with at least 38 hectares being rented for a minimum of three years (for those who planted a high proportion of bread wheat varieties, the average was over 100 hectares);
- His land is in the valley;
- He has the means to purchase a tractor and also has access to family labor;
- He has access to credit and to seeds, in particular to high-yielding varieties of bread wheat;
- He has easy access to a market, a distribution center, and extension workers; and
- He has a greater acceptance of bread wheat varieties because his own needs for consumption and his palatability requirements diminish.

From this profile, we realize that the constraints on the adoption of high-yielding varieties, and in particular of bread wheats, are great for the majority of farmers. In 1975, 64 percent of farmers in northern Tunisia had less than 9.9 hectares (even though 34 percent of those with less than 2 hectares and 69 percent of those with less than 10 hectares did use tractors).^{23/} The constraints to the adoption of high-yielding varieties of bread wheat (not high-yielding varieties of durum wheat which began to be widely adopted by all size farms in 1973) were particularly significant for these farmers, essentially as a result of their socioeconomic conditions and the lack of understanding of these conditions by policy-makers. Indeed, Roe and Nygaard pointed out that since their "results suggest that risk aversion is an important factor limiting the area planted to high-yielding varieties and causing the underutilization of resources, then knowledge of the human, farm and household characteristics associated with farmers' attitudes should be useful to extension agents and others."^{24/}

It was already noted above that an important factor in the subsistence farmer's behavior is the belief in security rather than speculation. The element of risk aversion is characteristic of farmers all over the world, and it becomes even more acute when farmers face radical changes in cultivation patterns not fully understood or proven to them. The element of risk is economically calculated by the farmer. His and his family's survival depend on it. This attitude is often erroneously explained by many as ignorance and a reactionary "mentality"^{25/} on the part of the farmer. The three studies mentioned above, based on extensive field surveys in the northern region, have proven, on the contrary, the farmer's astuteness in adapting to the new varieties most beneficial to his needs: the high-yielding varieties of durum. The new durum varieties were not only closer to the palatability criteria of the family and fulfilled consumption needs, but were less disruptive to the farmer for they required less resources and less technical expertise.^{26/} As a result, durum production as a proportion of overall cereals production is rising steadily (1981: 8 million quintals versus 1.6 million quintals of bread wheat).

A further constraint that was apparent in 1967, at the start of the project, has persisted throughout. In 1976, it was pointed out that "given the mission of influencing the demand for the new technology, [the wheat project] did not have any control over the supply of the essential inputs required by technology. Consequently, extension agents could very well sell farmers on the new ideas, but they did not have any way of ensuring the availability or the means necessary to put ideas to work."^{27/}

In addition to the bottleneck of lack of availability or irregular distribution of needed inputs for cultivation, the farmers were also faced with extension workers with less farming experience than themselves, unable to understand the conditions of the land or to adapt their knowledge to these conditions. Moreover, the age and length of farming experience of farmers indicated that most of those who adopted new varieties were not "new" farmers, suggesting a great reluctance on the part of the young, with limited experience in farming, to enter farming at all.^{28/} Having to rely on the older generation for production may well be one of the most significant factors in the overall agricultural development of Tunisia.

The extremely complicated mechanism of the credit system during that period was already noted above.^{29/} Added to this constraint was the highly unequal distribution of credit among the farmers. In 1972/1973, 27 percent of farmers obtained credit and many, it was said, did not need it.^{30/} In 1980, the situation still persisted, for it was viewed as one of the major constraints,^{31/} along with the agrarian structure, pricing policy, and lack of knowledge of the behavior of cereal producers, to prices and general policy. Yet the credit possibilities of small farmers have been facilitated since the land certification law of June 10, 1974. That law enabled farmers to obtain a certificate of land possession which allowed them to apply for credit without the previously required land title, a document which most small and medium farmers did not have. However, the certificate of possession, which eventually allowed title to the land, was not obtained without long administrative delays.^{32/} This accentuated social distinctions, increased unemployment, and supported profound economic differences between urban and rural populations, the latter still unable to obtain credit because of the difficulties of obtaining the certificates of possession.

C. General Social Aspects and Agricultural Labor in Tunisia, 1966/1975

In its introduction to "Social Aspects of Development in Tunisia," a World Bank report noted the following:

Overall social progress as measured by just about every thinkable social indicator is very good, certainly fully commensurate with Tunisia's per capita income level and often much better than that of many countries with comparable per capita income levels.... While absolute poverty is diminishing rapidly, there is still little cause for complacency. Rapid overall growth did not create sufficient opportunities for everyone. This means that the great resources allocated to social programs are not properly targetted to reach the poor.^{33/}

Thus, in 1975, 17 percent of Tunisia's 5,588,209 inhabitants lived below the poverty threshold, with a higher percentage in urban areas (20 percent) than in rural areas (15 percent). With a population growth of 2.3 percent in 1975, there has been a decline of 6

percent in absolute poverty since 1966 (23 percent) and an overall decline of those at the poverty threshold of 17 percent during that period (37 percent in 1975 versus 54 percent in 1966).^{34/} It should be pointed out, however, that though there is a higher percentage of absolute poor living in urban areas in relation to the urban population, it appears that 77 percent of the overall number living in absolute poverty were in the rural areas, 80 percent of these had families of 6 dependents (versus the national average of 5.5), and an average income of TD 29 per annum per person. For them to reach the poverty level of TD 50 per year, they would have had to increase their annual consumption by 10 percent by 1980 versus a national average of 6.6 percent.^{35/} The following categories and percentages express the levels of absolute poverty in rural areas^{36/} and reflect the situation which existed in northern Tunisia:

Small farmers.....	24.3 percent
Agricultural laborers and construction workers.....	40 percent
Small artisans.....	14.7 percent
Inactive.....	10.5 percent

The urban population growth has been extremely high since 1966: 4.3 percent versus 0-9 percent in rural areas,^{37/} with the average age of migrant males moving to cities, particularly to Tunis, between 20 and 30 years.^{38/}

Although the overall population growth diminished from 2.5 to 2.32 percent, 47.3 percent of the population is between 0 and 14 years old, versus 52.7 percent who are between 15 and 64 years old. However, the population bracket of 0-19 years old made up more than half the population in 1975 (2,989,370 from a total population of 5,577,250),^{39/} which was above the level in 1966 (45.3 percent). This increased the burden of rural families who were faced with a growing population, decreases in agricultural labor, and increased rural exodus.

Important quantitative results appear in the educational sector. Adult literacy was 32.1 percent in 1966; it was 65 percent in Tunis compared to less than 25 percent in the poorest rural governorates in the north, such as Beja, Jendouba, and Kasserine.^{40/} It is interesting to note, however, that enrollment in primary schools (ages 6-14) had declined between 1966

and 1978: 72 percent in 1966; 66 percent in 1975; 68 percent in 1978.^{41/} Quantitatively, and in relation to other countries at similar income levels, the national schooling level of 84 percent appears important. However, enrollment is closely correlated to the degree of urbanization, with 90 percent enrollment in urban centers versus 70 percent in rural areas.^{42/} Moreover, equity distribution in the educational sector for 1970 indicates a greater bias toward those of higher socioeconomic means pursuing higher education: 18 times more than those in lower economic brackets.^{43/}

This short synopsis of the evolution of poverty levels, urban growth, overall population, and education is presented for the relevance of its impact on rural life and needs. It is apparent from the education statistics that the opportunity cost of sending children to school is high for the rural population; thus the rural primary school population is characterized by low enrollment ratios (in spite of availability of space), high dropout rates, and a high degree of seasonal absence because the school year does not correspond to the agricultural year. Yet the educational system, not directed to rural and national needs, has been a factor in rural exodus, for education, as elsewhere in the developing world, is directed to urban values and conditions.

All these indicators have not diminished the high rate of general unemployment (15.7 percent) or the rural exodus, and as noted by the IBRD report, "Tunisia is faced with a disquieting unemployment problem,"^{44/} which affects half of the young people looking for jobs for the first time. Although the unemployment rate appears to have remained stable since 1959 (when it was also 15 percent), if underemployment in agriculture and services are taken into consideration, the effective rate of unemployment would be 30 percent.^{45/}

Emigration tends to alleviate the problem of unemployment, especially when it is officially directed. Between 1966 and 1975, an estimated 155,000 workers left for Germany, France, and Libya,^{46/} about 17,222 each year during this nine-year period.^{47/} This is about 4,622 more workers than in 1966, with the peak year being 1973, with 18,947 workers emigrating. Since 1975, however, emigration to Europe has drastically declined because of that continent's high inflation and unemployment problems. Libya remained the only outlet of any significance. In 1977, there were

27,313 Tunisian workers in Libya versus 494 in 1976.^{48/} In 1979, there was no net emigration from Tunisia. This fluctuation of emigration has had a great impact on unemployment patterns in Tunisia, in particular on agricultural labor. If many emigrants have returned, they have not returned to their rural areas.

The problem of agricultural labor and land distribution remains extremely critical in Tunisia. Agricultural employment declined from 54.3 percent of the labor force in 1966 to 38.0 percent in 1975, of which 13.6 percent were females active in agriculture, or 69,000 females versus a total of 8,000 in 1966; that is, 8.6 times more females became active in agriculture in one decade. A socioprofessional profile of the population active in agriculture^{49/} is a reflection of the differences existing between large farmers (mainly employers) and small farmers and of the importance of family help, composed mainly of women and children. This data reflected also on the situation in Northern Tunisia, the project area:

Employers	10,810
Independent	216,270
Salaried permanent	109,210
one employer	88,800
Salaried nonpermanent	82,110
several employers	20,410
Salaried nonpermanent	82,110
Family help	<u>93,860</u>
Total	512,260
Less those in forestry	<u>-12,060</u>
Total in agriculture	<u>500,200*</u>

*(69,000 females)

Since 1970, the number of small farmers and their share in total holdings has declined, while large farmers of more than 100 hectares have been on the increase, especially the largest ones (greater than 500 hectares). This change tends to encourage modern, capital-intensive production on large farms. In addition, the impact of price subsidies on inputs and of price policy in the absence of offsetting tax policy has

further distorted income distribution and agricultural employment, because of the greater productivity and market orientation of large farms. This has led to further pressure on land acquisition and mechanization to the detriment of the relative position of small-holders and landless rural labor. The finding of the consumption surveys that population distribution was rapidly deteriorating and that rural incomes are significantly lower than urban ones is thus fully corroborated by the agricultural survey.^{50/}

Table C-2 on the distribution of land and farmers by size of farm,^{51/} based on the national survey of 1975, is particularly reflective of the northern regions, the cereals production regions. The figures indicating diminution, between 1962 and 1976, of area owned by small farmers, and increases in areas owned by large farmers, especially those of 500 hectares or more, are telling and speak for themselves. One can only note that the situation has not changed greatly during that period. Indeed the large owners have increased by only 0.3 percent while their proportion of total acreage has increased by 10.5 percent.

Table C-2. Distribution of Land and Farmers
by Size of Farm, 1962 and 1976
(in percentages)

Size of Farm (hectares)	1962		1976	
	Proportion of Farmers	Proportion of Total Area	Proportion of Farmers	Proportion of Total Area
0-4.9	41.0	6.7	40.9	5.6
5-9.9	22.5	11.2	23.3	10.8
10-19.9	19.7	19.5	19.8	16.0
20-49.9	12.9	28.5	11.4	21.0
50-99.9	2.5	12.0	2.7	12.0
100-199.9	0.9	8.2	1.2	9.0
200-499.9	0.4	7.9	0.3	9.1
500 or more	0.1	6.0	0.4	16.5

Source: IBRD, Tunisia, Social Aspects of Development,
1980, p.56.

D. Consumption and Nutrition in 1975

Income distribution in 1975 expressed a widening gap between poor and rich in Tunisia after 1966 and was reflected in the level of food expenditures by each group and in the wide differences between urban and rural development. Table C-3 highlights the fact that while 5 percent of the top income brackets have 22 percent of all income, the lowest 20 percent of income brackets have 5 percent of all income. That is, the top 5 percent in 1975 had five times more than the poorest 20 percent, compared to 2.4 times more in 1966, keeping in mind that 49.83 percent of the population was urban (versus 39.9 percent in 1966) and 50.17 percent was rural (versus 60.1 percent in 1966).^{52/} Thus urban and rural were almost equal in size in 1975.

Table C-3, Distribution by Income Group,
1966 and 1975
(in percentages)

Year	Lowest 20%	Lowest 40%	Middle 40%	Top 20%	Top 5%
1966	6.0	17.1	36.7	46.2	18.0
1975	5.0	15.0	35.0	50.0	22.0

Source: IBRD, Tunisia, Social Aspects of Development, 1980, p. 53.

The 1975 Consumption Survey showed that 32 percent of rural inhabitants, 19 percent of urban inhabitants of small cities, and 4 percent of the population of large cities fall within the two lowest income classes, under TD 60 per annum.^{53/} This data, differently presented, indicate the following:

- 49 percent of the population earned less than TD 100;
- 47 percent of the population earned between TD 100 and TD 400; and
- 5 percent of the population earned more than TD 400.

This also means that the first group accounts for 20 percent, the second group for 58 percent, and the third group for 22 percent of total expenditures.^{54/} The close relationship in total expenditures between the lowest and highest groups should be noted (20 and 22 percent, respectively).

The national average total family budget per person per annum amounted to TD 147, of which 41.7 percent was for food expenditures and 28 percent for lodging.^{55/} Within total food expenditures, the national average per person per annum was 21.4 percent for cereals, 2.7 percent for pulses, 16 percent for vegetables, and 18.2 percent for meats.^{56/} Cereals, therefore, remained the highest part of food expenditures, while diminishing as an overall share of expenditures since 1966 (35 percent of food expenditures).

The pattern of food expenditures in the total household budget varies according to the geographic environment. Table C-4 indicates that the share of food expenditures was higher in rural areas than in urban areas.

Table C-4 Structure of Food and Nonfood Expenditures According to Milieu, 1975 (in percentages)

Expenditures	Large Cities	Small Urban Areas	Rural Areas
Food Expenditures	37%	41%	48%
Nonfood Expenditures	63%	59%	52%

Source: Enquete Nationale sur le Budget et la Consommation des Menages en Tunisie, 1975, Tunis, p. 228.

Cereals as a percentage of food expenditures were also higher in rural areas than in the other two categories: 17.6 percent in large cities, 21.7 percent in urban areas, and 24.4 percent in rural areas.^{57/} This was in spite of the fact that 32.2 percent of cereal expenditures from households budgets were for family grown cereals, and were thus part of the cereals grown for home consumption.^{58/}

Cereal consumption has increased from an average of 145 kilograms per annum per person in 1968 to 181.29 kilograms in 1975, with 203.57 kilograms in rural areas versus 149.76 kilograms and 163.66 kilograms in large cities and urban areas, respectively.^{59/} A similar distinction exists when comparing durum consumption (for couscous, noodle products, and traditional bread) with bread wheat consumption (for French bread) according to region (see Table C-5 below).

As in 1968, the exact reversal between rural areas and large cities of type of cereal consumption also occurred in 1975. It is informative to break down each cereal type by its transformed products. In durum wheat in 1975, the consumption of semolina and spaghetti products (98.4 kilograms) were more than double the consumption of couscous (44.90 kilograms) in rural areas, while French bread made up two-thirds (20.37 kilograms) of the bread wheat consumption (34.39 kilograms).

Table C-5 Cereal Consumption Per Capita Per Annum, 1975
(in kilograms)

Product	Total Consumption			Average
	Large Cities	Small Urban Areas	Rural Areas	
<u>Durum</u>				
Borghon	0.20	0.31	0.16	0.24
Semolina	7.48	23.83	83.71	51.03
Couscous	13.81	27.33	44.90	33.46
Noodles	14.89	20.20	14.76	16.36
Other	<u>3.41</u>	<u>5.73</u>	<u>8.67</u>	<u>6.73</u>
Total	39.79	77.40	152.20	107.82
<u>Bread Wheat</u>				
Flour	2.06	6.92	14.02	8.91
French Bread	<u>99.40</u>	<u>73.67</u>	<u>20.37</u>	<u>52.36</u>
Total	101.46	80.59	34.39	61.27

Source: From Table 501, Consumption Survey, Ministere du Plan, GOT, 1975, p. 364. (See footnotes 12 and 55.)

Such details did not appear in the 1968 Consumption Survey, yet its categories of French bread, noodle (or spaghetti) products, and other cereal products (couscous) give us enough of an indication of the great changes that had occurred by 1975 (see Table C-6). It can be noted that in 1975 French bread consumption had doubled in large cities (urban area category) and more than tripled in small urban and rural areas (rural category). Couscous, included in all durum products in 1968, had decreased in all areas in 1975, while noodle products had decreased in urban areas by almost half but had more than doubled in rural areas.

Table C-6 Cereal Consumption Per Capita
Per Annum, 1968 and 1975
(in kilograms)

Product	Large Cities		Rural Areas		Average	
	1968	1975	1968	1975	1968	1975
Noodles, etc.	24	14.89	13	34.99	15	24.94
Other Durum Cereals						
(couscous)	47	24.70	125	87.16	105	55.93
French Bread	58	99.40	16	93.97	27	96.68

Source: based on Table 2-2, Consumption Survey, 1968, p. 157; and Table 501, Consumption Survey, 1975, p. 364. (See footnotes 12 and 55.)

If the overall nutritional indicators in Tunisia have improved since 1966 (see Table C-7) the deficiencies are still high and are particularly in evidence in rural areas. Moreover, while cereals consumption had increased, it should be recalled that the increase, as shown in Tables C-5 and C-6, is particularly high in the transformed and refined products, while consumption of the more nutritionally complete couscous and traditional whole wheat bread has decreased. An important phenomenon related to this change is the high ratio of women in the labor force, in particular the increasing role of women in agricultural labor, where they are filling the gap left by the exodus

of males to cities and overseas. Women now have less time to prepare the time-consuming couscous and traditional bread.

Table C-7. Nutritional Indicators Percentage of Population Below Minimum Caloric Intake, 1966 and 1975

<u>Area</u>	<u>1966</u>	<u>1975</u>
Urban	25.0	18.0
Rural	12.0	9.0
Total	30.0	14.0

Source: IBRD, Tunisia, Social Aspects of Development, 1980, p. 30. (See footnote 1.)

Research at the National Institute of Nutrition has shown that malnutrition is high and particularly affects infants. It also has indicated that differences in earning capacities of income groups is an important factor in the ability to acquire a balanced diet.^{60/}

Unfortunately, no detailed data exist for 1975 that could be used to create cereals consumption and caloric intake maps similar to those drafted for 1968 by the Institute of Nutrition in Tunis (see maps in Appendix D, Figures D-6 and D-7). The Consumption Survey of 1975 does present, however, the caloric intakes according to the three major categories: large cities, small urban centers, and rural areas.

It is noted that an increase in caloric intake occurred in rural areas, while the caloric intake decreased in urban areas (see Table C-8).

Table C-8 does not reflect the discrepancies which existed according to income and regional differentiations. Table D-34 in Appendix D shows the daily caloric intake according to income levels and regions.

Table C-8. Average Caloric Intake
Per Person Per Day, 1975

	Large Cities	Small Urban Areas	Rural Areas	Average
Calories	2416	2432	2652	2543
Caloric Percentage of Cereals Consumed	47%	53.9%	62.7%	57%
Caloric Percentage of Meats Consumed	11%	6.7%	5.7%	7.8%

Source: Based on Consumption Survey, 1975, p. 375.
(See footnote 55.)

The importance of maintaining palatability in diets, as expressed by farmers' cultivation of durum wheat because palatability is an important criterion,⁶¹ cannot hide the poor nutritional situation that prevails in rural areas and among low-income groups in urban centers. It may not be possible to generalize that the increase in type of cereal consumption--from couscous to French bread--may have been a causal factor. It could be assumed, however, that it is one of the reasons, or variables, limiting better nutrition and more balanced food consumption in Tunisia.

IV. SOCIAL SETTING AFTER THE PROJECT, 1975-1982

In 1980, a World Bank report pointed out that the basic social issue in Tunisia is still the need for better use of its available resources. It adds that "available information clearly shows that differences between groups are much higher than differences within groups" and that contradictions exist between policy measures, as in the case of employment creation and price subsidies. It concludes by saying that "employment creation and an efficient price system may

well be the key to solving the remaining social problems as well."62/

A. General Assessment: Constraints on Farmers and Land Tenure Situation

One of the major constraints on farmers in Tunisia is rainfall variability. It is the first source of risk and uncertainty. It makes bread wheat cultivation, which is especially susceptible to rainfall irregularity, a particularly risky enterprise for small and large farmers alike, though the latter have the resources, the land, and the capital to allow them to take the risk. Yet other major constraints exist and were already of enough concern to the Government of Tunisia in 1977 for it to request strategy recommendations from a CIMMYT team for improving efficiency in wheat production.63/

Highlights of this report are particularly pertinent to cereal production conditions and reflect on the situation which still exists today.

- The question concerning adaptability of technology was raised at the outset of the report, that is, whether appropriate technologies were available for each of the important situations under which wheat is produced.64/
- Few farmers interviewed agreed with the officially recommended levels of inputs for optimum yields made by extension workers, seeing them not as being in their best interest but rather as increasing their risk too much for the amount of expected additional production.65/ This implies that the farmers' calculations were based on what could be the most stabilizing and most financially feasible ways to meet their production needs on the basis of their knowledge of their own optimum conditions.
- "Leading farmers," those whose high yields are used by agricultural officials as the model for goals, "undoubtedly have better than average land."66/

- To the question of why there is a yield gap in Tunisia, the team indicated that although little research data are available on regional differences, barley production should be considered when high-yielding varieties prove inefficient.^{67/} The important inference to make from this recommendation and the previous comment is that high-yielding varieties do not apply to all soils nor to all farmers. Thus gaps are not necessarily due to the farmers' resistance or lack of know-how (which may nevertheless be a factor) but to varying agronomic and climatic conditions.
- A difference of assessment appeared between Tunisian senior officials and the team members about the constraints to the use of recommended inputs. The former felt that uncertainties in land tenure, lack of access to information and credit, and the need to reach the small farmers were the essence of the problem. The latter believed that all farmers were aware of the value of inputs and that the problem resided in the management of input distribution and cumbersome credit procedures, as well as pricing policies.^{68/} Our own observations and contacts, five years after the assessment of the CIMMYT team, tends to support the latter assessment. Land tenure may indeed be a constraint to efficient production because of the extensive parcelling of the land, but infrastructure, management, and coordination of services are greater elements of distress to the farmer.^{69/}
- One of the most important problems raised by the team concerns the type of institutional relationship that should be established with the farmer: "programs should focus on problems and opportunities confronting the farmers--the farmers must be seen as the primary client." They further add, concerning work on varieties and agronomy, "both areas could be made more effective were there stronger feedback from farmers."^{70/}

Though the report is essentially an agronomic state-of-the-art of the cereals production program, the five points raised above (appropriate technology, optimum levels of yields, yield gaps, management, and

institutional relationship with farmers) have fundamental sociological implications, for in each instance the farmer's conditions, knowledge, awareness, and capabilities are taken into consideration for a more feasible production system. Failure to do this has created a bottleneck in that system, hindering small- and medium-size farmers from adapting rationally to a complicated and expensive process of change while enabling large farmers to adopt the system without difficulty.

Further constraints that directly affect the farmer should be added to the above. They are, however, part of the overall development process to which national solutions must be found.

- The agrarian structure does not allow the majority of farmers to adjust to the needs of cereals production. The small minority of large farmers (several of whom have over 1,000 hectares of the best lands, the plains) can use the technological package to its optimum advantage.
- The above constraint has led many small farmers to rent out their land, thus allowing access to their land by larger farmers. On the other hand, this eliminates the problems of parcelling of the land and allows more efficient production. Thus, the contradiction arises between production needs and farmers' needs.
- Rural exodus has literally emptied the rural areas of their potentially active youth and young adults. The average age of farmers was 50.8 years in 1975, and was even higher in 1982, when it was close to 55 years old.^{71/}
- Limitations presently set on international migration by foreign countries will not encourage youth to return to agriculture. Indeed, many of the returnees remain unemployed in small and large cities. They have little incentive to enter the agricultural sector, where salaries are below the official minimum for an acceptable level of livelihood, and there is little hope of expanding their land, if they have any. Not only is land almost

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unavailable for purchasing but the price of land has risen so that it has become inaccessible to most.^{72/}

The lack of labor has encouraged an impressive majority of all size farmers to use tractors today, particularly at the crucial periods of harvesting and seed-bed preparation. Indeed, even a farmer owning only 9 hectares rents a tractor. This amounts to a total of about 30 hours of tractor rental for a total cost of TD 120 or 150.^{73/} The farmers have two sources for tractor rentals: a service cooperative or private owners. Great dissatisfaction exists with service cooperatives in all areas visited because farmers feel that they cannot rely on them and tractors usually are not delivered on time. These cooperatives have great problems with repairs and spare parts and do not seem to be able to meet all the requests before them. On the other hand, the private owners of tractors are said to be always reliable. The personal relationships developed between owner and renter make contact more satisfactory and more direct. Yet tractors are not always available, for a private owner does not necessarily have the time to cover his needs (if he operates his own farm) as well as those of neighbors.^{74/} Thus, for 1980, 40 percent of farms of 0-10 hectares used tractors, while 73.3 percent of farms of 20-100 hectares and 100 percent of farms over 100 hectares used tractors,^{75/} with those in the latter category fully owning their tractors.

The situation of agricultural labor today is critical and is often the determining factor for the farmers in making the choice of crops to cultivate. Crops which require the least monitoring and time are natural first choices.

In an initial draft analysis by the Division of Statistics at the Ministry of Agriculture it was noted that out of 355,000 farmers surveyed, 128,000 (or about 45 percent) spent less than half an agricultural year on a farm, and 141,000 have another activity that allows 60 percent of them to spend 36.6 percent of the farmers work full time on a farm (this percentage includes family help, that is women) (see Table C-9).^{76/}

Table C-9. Structure of Agricultural Labor
in Northern Tunisia, 1980
(in 1,000's)

	Permanent Active Laborers ^{1/}		Temporary Family Aid		Permanent Salaried ^{2/}		Temporary Salaried ^{3/}	
	Male	Female	Male	Female	Male	Female	Male	Female
NE ^{4/}	80.8	20.93	15.21	21.14	15.58	980	22.7	16.9
NW ^{5/}	97.7	37.89	19.33	13.07	15.13	310	10.24	7.93

1/ Includes owners and permanent family members active full-time.

2/ Average work days per year for NE: males: 280; females: 275; and for NW: male: 247; females: 307.

3/ Average work days per year for NE: males: 17; females: 11; and for NW: males: 17; females: 13.

4/ Total population of NE: 2,131,000.

5/ Total population of NW: 1,068,000.

Source: Ministry of Agriculture, Division of Statistics, Tunis, 1981.^{77/}

Between 1976 and 1980, salaried agricultural labor diminished by 41 percent. The reason for such a decrease is not clear from the statistical analysis. However, in the opinion of one farmer in the Beja region, one explanation is that the young hate agriculture and only 1 percent stay in it because they are forced to, and, he added, they know nothing about farming. Thus, of the 30 or so small farmers interviewed on our field trips; only one was less than 30 years old, while all the others were over 50 years old. This young farmer was forced into farming, and had to quit school to take care of his small 9-hectare farm after his father's death. He knew of no other farmer in his region in his age bracket. Such situations cannot help but exacerbate the ownership structure in Tunisia. Table C-10 on land ownership in Tunisia in 1977 reflects this, and though it refers to overall ownership in Tunisia, it applies to the northern regions as well. Table C-11 on the land ownership structure in northern Tunisia in 1977 highlights this fact and allows a comparison with the overall ownership structure in Tunisia.

Table C-10. Land Ownership Structure in Tunisia, 1977

Size of Farm in Hectares	Percentage of Farmers	Percentage of Land	Average Size Per Farmer
1-5	40.8	6.1	2.3
5-10	22.4	10.2	7.0
10-20	19.72	17.7	13.8
20-50	12.9	26.0	31.0
50-100	2.6	11.2	67.7
100-200	0.9	8.5	142.3
200-500	0.5	9.32	132.0

Source: Based on data provided by the Food and
Agriculture Division, USAID/Tunis, 1977.

Table C-11. Land Ownership Structure in Northern
Tunisia, 1977

Size of Farm in Hectares	Number of Farmers	Percentage	Hectares	Percentage
0-10	63.930	66	248.300	13
10-50	28.000	28	611.200	32
over 50	<u>5.370</u>	<u>6</u>	<u>1,050.500</u>	<u>55</u>
Total	97.300	100	1,910.000	100

Source: CNEA, Project de Credit Agricole, Ministere
de l'Agriculture, Tunis, 1977, Annex 11, p. 1.

On the basis of the data gathered, the interviews with senior officials, and field trips undertaken in the region, it can be concluded that the cereals production program of Tunisia has added greatly to the already unbalanced land ownership structure and to the labor exodus from rural areas. The very essence of the need for greater production using intensive mechanization has favored the large farms and has created a contradiction between attempts to reach equitable income distribution and a technologically oriented production system that has not managed to adjust to the capabilities of the majority. Added to this, the lack of coordination, shortage and late distribution of inputs, and shortage (in quantity and qualifications) of extension personnel reflect the inability of the infrastructure to adjust to the nation's production

goals. Moreover, as will be seen below, consumption patterns have not greatly improved as a result of cereals production.

B. Consumption in 1980

All farmers, small and large, keep part of their durum cereal crop for their own consumption. All have a preference for the traditional variety called Mahmoudi over the new high-yielding varieties, and a good portion of small farmers still plant Mahmoudi, essentially for home use. However, most farmers quite dramatically adopted the high-yielding varieties, not only because of their high yields, but also because of their speculative possibilities. The most popular variety of high-yielding durum is one crossed with the traditional Mahmoudi variety. The variable factor of palatability discussed above is still an important criterion for the small farmer.

It is not possible to determine the changes in consumption patterns between 1975 and 1980, for no data were available to us, even though a consumption survey was undertaken in 1980. In 1971, the minimum agricultural wage (SMAG) was TD 0.634 a day; today, in 1982, it is TD 2.400 per day or TD 65 per month. The most substantial increase occurred however, in 1981, when social security benefits were given to agricultural workers for the first time. Data in Table C-12 from the Institute of Nutrition in April 1982 show great differences in caloric intake based on differences in 1980 income levels.^{78/}

Table C-12. Relationship Between Income Levels and Daily Caloric Intake Per Person, 1980

Income/Year	Calories/Day
Less than TD 70	1,881.34
TD 100	2,145.64
TD 130	2,234.35
TD 200	2,307.54
TD 300	2,449.73
TD 300-500	2,558.57
Over TD 500	2,738.52
Average	2,347.38

Source: National Institute of Nutrition, Interview, April 11, 1982.

An unpublished draft on the identification of households with consumption deficiencies based on the 1980 Consumption Survey indicates that food expenditures in urban areas are twice as much, as in rural areas, an apparent change from 1975 data.^{79/}

There is presently no way for us to determine the poverty threshold level or the actual amount of cereal consumption, yet we could infer from that draft analysis that the poverty threshold has not changed greatly since 1975 (Table D-34), for it corroborates Table C-12 by noting that 50 percent of households at the TD 50 (per year) income level have a 57.5 percent caloric deficiency, 14 percent of households at the TD 50 to TD 60 income level have 39.6 percent caloric deficiencies, and 9 percent of households at the TD 60 to TD 70 income level have 32.4 percent caloric deficiencies.^{80/} Indeed, it was already noted in an earlier World Bank report that one out of every six Tunisians lived in absolute poverty in 1980.^{81/}

It is the belief of researchers at the National Institute of Nutrition that the ever-increasing consumption of French bread at the expense of couscous and traditional bread has been a contributing factor to the deficient nutritional levels and caloric intake. The ever-increasing time spent by women in the fields has also been a factor in this change. Moreover, no more nutritious foods have been adopted to fill the growing nutritional gap, for consumption of meat or milk products has not increased in rural diets.

V. SUMMARY OF SOCIOLOGICAL ANALYSIS: SOCIAL IMPLICATIONS OF CEREAL PRODUCTION IN NORTHERN TUNISIA, 1956-1982

At the eve of independence in 1956, Tunisia's northern farmers were divided into three distinct groups: (1) a small minority of French colons who had a majority of the best arable land, (2) an even smaller minority of Tunisian large farmers who had a small percentage of good arable land, and (3) a large majority of Tunisian small farmers who were pushed to the leftover, less arable hillside lands. By the time the French were expelled from their farms, they had worked the land to its optimum capacity using it as if it were a mine, as a French economist later wrote.

After independence and until August 1969, an attempt at land reform for the purpose of better utilizing the land for production was undertaken in Tunisia. Almost all private land was cooperatized into small- and medium-size productive cooperatives and State farms. This experience proved extremely negative because of the lack of institutional support existing in the country, lack of management and technological know-how, and especially lack of incentives and great resistance on the part of small and big landowners alike. Quite abruptly, in September 1969, the cooperative movement was reversed to private ownership and 66 percent of members abandoned the cooperatives. This led to the chaotic situation in which small farmers, devoid of the means necessary to reinstate themselves on their land, were forced to rent or sell out their land, while large private owners were thus able not only to expand their farm surfaces but also to adjust to more modern farming technologies, because of their personal means, previous farming investments, ability to acquire credit, and employment opportunity offered by them for available labor.

It is at this point of social and economic disarray that the Wheat Development Program started its first campaign. It found itself faced with an agrarian structure it had not envisioned and constraints to its own development on all levels. This, however, did not keep the project from starting off with a high level of enthusiasm, from the foreign expert to the national extension worker. In retrospect, one realizes that the initial goal of the project, which had accepted the national development goal of food self-sufficiency, had been centered only on the technical aspects of production. The social and economic capabilities of the majority to absorb all the requirements of the technological package, which was part and parcel of the project, were not taken into consideration. This has had a long-term impact on the adoption of bread wheat varieties in the northern region.

The first three years of the project were crucial to the very working and redefinition of its goals (from production increases to institutional and training goals), and to the understanding of the environment it was dealing with, not only climatic and agronomic, but socioeconomic as well. Several conclusions of social significance were to emanate from these early campaigns:

1. The production goal which required a packaged technology was not adapted to the capabilities of the majority of farmers, and allowed the minority of larger farmers to expand their farms.
2. The extensive use of mechanization increased an already vast rural exodus and emphasized the weakness of distribution centers in meeting repair needs and providing spare parts necessary for intensive mechanization.
3. The program focused on wheat production to the exclusion of crop diversification and cattle raising which were necessary for economic and consumption reasons for most farmers; since 1974, there has been a gradual change in this factor, which has been even more adopted since 1980.
4. The initial success of high-yielding varieties of bread wheat was due to the fact that these were cultivated on the most fertile lands in the most suitable rainfall areas.
5. The choice by farmers of the type of wheat to cultivate was based on palatability of produce and economic risk aversion, factors which had long-term impacts on production by increasing durum wheat at the expense of bread wheat.

Various constraints plagued the project and the farmers throughout the project period and, indeed, still remain important today. Some of these constraints are essentially linked to infrastructure and management, and include the following:

1. Insufficient number of extension workers and inadequate expertise to meet the needs of the farmers;
2. Insufficient number of distribution centers and insufficient inputs to distribute when demand from farmers increases;
3. Inefficiency of service cooperatives in meeting needs because of the growing use of farming machinery by small farmers;

4. Complicated and inequitable credit system; this system has recently improved through decentralization that allows greater flexibility in each governorate;
5. Perhaps the most important constraint is the agrarian structure which has changed little since independence, except for the short interlude of cooperatives. It is characterized by land parcelling which renders production inefficient and increases the mechanization costs of farmers, thus forcing many small farmers to sell or rent out their land. On the other hand, it allows more efficient but also more speculative production by large farmers. The following statistics highlight this fact in northern Tunisia where 66 percent of farmers with 0 to 10 hectares work on 13 percent of the arable land while 6 percent of farmers with over 50 hectares have 55 percent of the arable land, a greater majority of them having over 100 hectares.

The situation in agricultural labor is deteriorating in Tunisia, and in spite of the high rate of unemployment, agricultural labor decreased by 41 percent between 1975 and 1980. This evolution has led to an ever-increasing integration of women (some salaried but most unsalaried) into the agricultural labor force and an older average age of farmers, which today is about 55 years old.

This factor has greatly affected the already deficient consumption patterns and nutritional levels in Tunisia. Women have little time to devote to making the time-consuming traditional meals which are durum based. Between 1968 and 1980, the increased consumption of French bread (refined bread wheat product) has been dramatic in relation to couscous, the traditional meal in rural areas. Moreover, even though bread is subsidized, household food expenditures in rural areas are a higher part of the household budget than in urban areas. The data also highlight the fact that food expenditures are higher in the lowest income groups than in the higher income groups. Though the poverty and absolute poverty levels of Tunisia have greatly decreased in the past 10 years, they are still high for a country that falls theoretically in the international middle-income group.

Positive and negative impacts have resulted from the project and from the national agricultural policies which it supports. The most important positive impact is the adoption by all farmers, particularly small farmers, of high-yielding varieties of durum wheat. This is particularly significant if it is recalled that these farmers are mostly of the older generation, and therefore theoretically the most conservative and least resilient. The project was also instrumental in changing the relationship between farmer and extension worker to one of dynamic and direct contact in the field and in creating a greater awareness by all farmers of the need to adapt to the use of the new agricultural inputs.

The negative impacts are particularly obvious in the contradiction that has arisen between production needs and farmers' capacity to adjust to these needs. The technological package of production has increased credit possibilities to farmers; this, in turn, has created greater burdens of indebtedness and larger monetization needs, especially for small- and medium-size farmers. The mechanization of agricultural production became a part of a vicious cycle in the national problem of increasing unemployment and rural exodus, as both a cause of and a solution to it. Finally, in spite of the positive element of a growing integration of women into the agricultural labor force as a result of male rural exodus, this factor has had a direct impact on consumption patterns, adding to poor nutritional habits in Tunisia. French bread and noodle products have become the fast foods of rural Tunisia.

FOOTNOTES

1/ IBRD (World Bank), Tunisia, Social Aspects of Development, Washington, D.C., June 1980, pp. 9, 10. Those living in absolute poverty are those with expenditures below the proposed poverty threshold and who, by definition, would eventually die of starvation and/or exposure.

2/ IBRD, op. cit., Tunisia, Social Aspects of Development, p. 11.

3/ H. Van Wersch and T. Daves, Retrospective of Tunisian Agriculture: 1962-1971, Office of International Agricultural Programs, University of Minnesota, 1974, p. 32.

4/ I. Hauri, "Le Projet Cerealier en Tunisie," Geneva: 1974; p. 8 notes that the average colon farm was 250 hectares while the modern Tunisian farm was 100 hectares.

5/ A. Binnendijk, Assessment of Tunisia's Development Efforts and AID's Contribution, AID, DS/DIV/ESDS, Washington, D.C., 1980, p. 34.

6/ S. Gafsi, Green Revolution: The Tunisian Experience, CIMMYT, Mexico, 1976, p. 6.

7/ IBRD, The Economic Development of Tunisia, Main Volume, World Bank, Washington, D.C., December 1974, p. 30.

8/ Ibid, p. 31.

9/ Ibid, p. 33.

10/ I. Hauri, op.cit., p. 6, quoting Mazoyer.

11/ Comite Sectoriel...1969, Annex Table 2. We know from the 1975 Consumption Survey that national average cereal consumption per capita per annum was already 181.29 kilograms with 203.57 kilograms in rural areas (p. 354).

12/ Enquete Nationale sur le Budget et la Consommation des Menages en Tunisie, 1965-1968, GOT, Ministere du Plan, 1968, p. 163.

13/ IBRD, op.cit., Tunisia, Social Aspects of Development, p. 35.

124.

14/ Dana G. Dalrymple, Economic Aspects of Nutrition Improvement in Tunisia, USDA/AID, Washington, D.C., 1970. The author notes, however, that surveys in the United States have shown that "there is a loose association between income level and nutritional quality of diets."

15/ Ibid., p. 27-28. Dalrymple noted that while the local Tunisian bread wheat variety (Florence-Aurore) had 14.9 percent protein of which 2.89 percent was lysine, the HYVs had 14.5 percent protein, of which 2.99 percent was lysine.

16/ Data from Cereals Board, unpublished tables: "Cereales: Superficies et Production 1920-1981;" and "Recensement Moyen des Varieties dans les Essais de la Division Technique, 1967-1980." It should also be noted that durum cultivation was even higher in earlier preproject years, 1953, 1956, 1959, and 1960, with over 1 million hectares cultivated.

17/ Hauri, op.cit.

18/ The distribution of seeds in a village was invariably late because of a complicated highly centralized administrative routine: (1) the Union National des Agriculteurs (UNA) made the decision on who was to obtain seeds, made the list, and sent it to (2) the regional "adjoint technique" (extension worker) of the Projet Cereale who sent it to (3) the Central Office of the Projet Cereale which sent it to (4) the Central Office of the UNA which forwarded it to (5) the main Office des Cereales which sent it to the regional Office des Cereales. (Ibid. pp.50-51).

19/ In 1969/1970, 50,000 hectares were seeded in high-yielding varieties; in 1970/1971, 100,000 hectares in high-yielding varieties; in 1971/1972, 50,000 hectares instead of the goal of 200,000 were seeded.

20/ Salem Gafsi, "Green Revolution: The Tunisian Experience," Ph.D. Thesis, University of Minnesota, 1975; Salem Gafsi and Terry Roe, "Adoption of Unlike High Yielding Wheat Varieties in Tunisia," in Economic Development and Cultural Change, Vol. 28, No. 1, October 1979; Terry Roe and D. Nygaard, Wheat Allocative Error and Risk: Northern Tunisia, Department of Agriculture and Applied Economics, University of Minnesota, March 1980.

21/ Mohamed Ben Senia, "Supply Response of Cereals in Tunisia," Ph.D. Thesis, Iowa State University, Ames, Iowa, 1981.

22/ See Gafsi, op.cit., passim; Gafsi and Roe, op.cit., passim; Roe and Nygaard, op.cit.; passim. (See footnote 20.)

23/ Roe and Nygaard, op.cit., p. 2. (Footnote 20.)

24/ Ibid., p. 12..

25/ "La mentalite du paysan" (the peasant mentality), implying the generic characteristic of backwardness, is a frequent phrase heard from Tunisian extension workers.

26/ Gafsi, op.cit., p. 38. (Footnote 20.)

27/ Ibid., p. 5.

28/ Ibid., p. 15.

29/ See footnote 18.

30/ Ben Senia, op.cit.

31/ Ibid.

32/ FAO, Rapport National de la Tunisie, Rome, 1979, p. 103.

33/ IBRD, op.cit., Tunisia, Social Aspects of Development, pp. i-ii.

34/ Ibid., p. 11.

35/ FAO, op.cit., pp. 68-69.

36/ Ibid., p. 68.

37/ Ibid., p. 68.

38/ Ibid., p. 53.

39/ Ibid., pp. 5 and 8.

40/ IBRD, op.cit., Tunisia, Social Aspects of Development, p. 17.

41/ Ibid., p. 17.

42/ FAO, op.cit., p. 29.

43/ Ibid.

44/ IBRD, op.cit., Tunisia, Social Aspects of Development, p 5.

45/ Ibid., p. 6.

46/ Binnendijk, op.cit., p. 19.

47/ In 1972, the age breakdown of the 170,000 workers overseas reflected the high proportion of young adults leaving: (i) less than 20 years old, 6 percent; (ii) 20-29 years old, 55 percent; (iii) 30-39 years old, 28 percent; (iv) 40 years old and older, 11 percent (IBRD, op.cit., The Economic Development of Tunisia, p. 31).

48/ GOT, "Annuaire Statistique de la Tunisie," Institut National de la Statistique, 1976-77, p. 162.

49/ FAO, op.cit. p. 43.

50/ IBRD, op.cit., Tunisia, Social Aspects of Development, p. 56.

51/ Ibid.

52/ GOT, Recensement General de la Population et des Logements, Institut National des Statistiques, Tunis, May 1975, p. 50.

53/ J. Perisse and A. Kamoun, "The Price of Satiety: A Study of Household Consumption and Budget in Tunisia"; FAO, Food and Nutrition, Vol. 7, No. 2, 1981, pp. 3-10.

54/ IBRD, op.cit., Tunisia, Social Aspects of Development, p. 39.

55/ GOT Consumption Survey, 1975, Ministere du Plan, p. 209.

56/ Ibid., p. 213.

57/ Ibid., p. 233.

58/ Ibid., p. 234.

59/ Ibid., p. 352.

60/ IBRD, op.cit., Tunisia, Social Aspects of Development, p. 30.

61/ Gafsi and Roe, op.cit., passim. (See footnote 20.)

62/ IBRD, op.cit., Tunisia, Social Aspects of Development, p. ii.

63/ "A Report on Tunisian Wheat Production Prepared by CIMMYT and Collaborators," n.d., (1977).

64/ Ibid., p. 1.

65/ Ibid., p. 8.

66/ Ibid.

67/ Ibid., p. 7.

68/ Ibid., pp. 8 and 25.

69/ Ibid., p. 29. Emphasis added.

70/ Ibid., p. 30.

71/ Observation in the fields; also confirmed in an interview with Mr. Sahnoun, Director, Statistics Division, Ministry of Agriculture, April 21, 1982.

72/ On the slopes of the hillside of Beja, a small farmer who today has 18 hectares had bought his land in 1967 for TD 55 per hectare. Today, that same hilly land would cost TD 600 to TD 700 per hectare. A farmer close to the plains of Beja who bought 18 hectares with his three brothers in 1972 for TD 700 would have to pay TD 1,200 today. (Beja field interview, April 22, 1982.)

73/ Field interview on hillside of Beja region, April 22, 1982.

74/ In the APMANE credit program for small- and medium-size farmers in northeast Tunisia, tractors are sold on credit. Owners are asked to share their tractors but this is merely a moral obligation that is not always carried out (Fahs and Beja interviews).

75/ Ben Senia, op.cit.

76/ Table D-35 (see statistical Appendix D) allows a comparison between active population in agriculture in 1980 and family aids according to region within the cereals production area as a whole.

77/ Based on data obtained from Mr. Sahnoun, Director of Statistics Division, Ministry of Agriculture, Interview, April 21, 1982.

78/ It was also asserted during that interview, April 19, 1982, that in the Tunis area 9 out of 10 breads were made of imported wheat, while in the rural areas and other cities of the north, bread is made mostly from local wheat, but the preference in these areas is for Tunis bread and rurally made French bread.

79/ GOT, Note Methodologique sur l'Identification des Menages Deficitaires en Calories, Institut National des Statistiques, 1980, draft, p. 4.

80/ Ibid., p. 10.

81/ IBRD, op. cit., Tunisia, Social Aspects of Development.

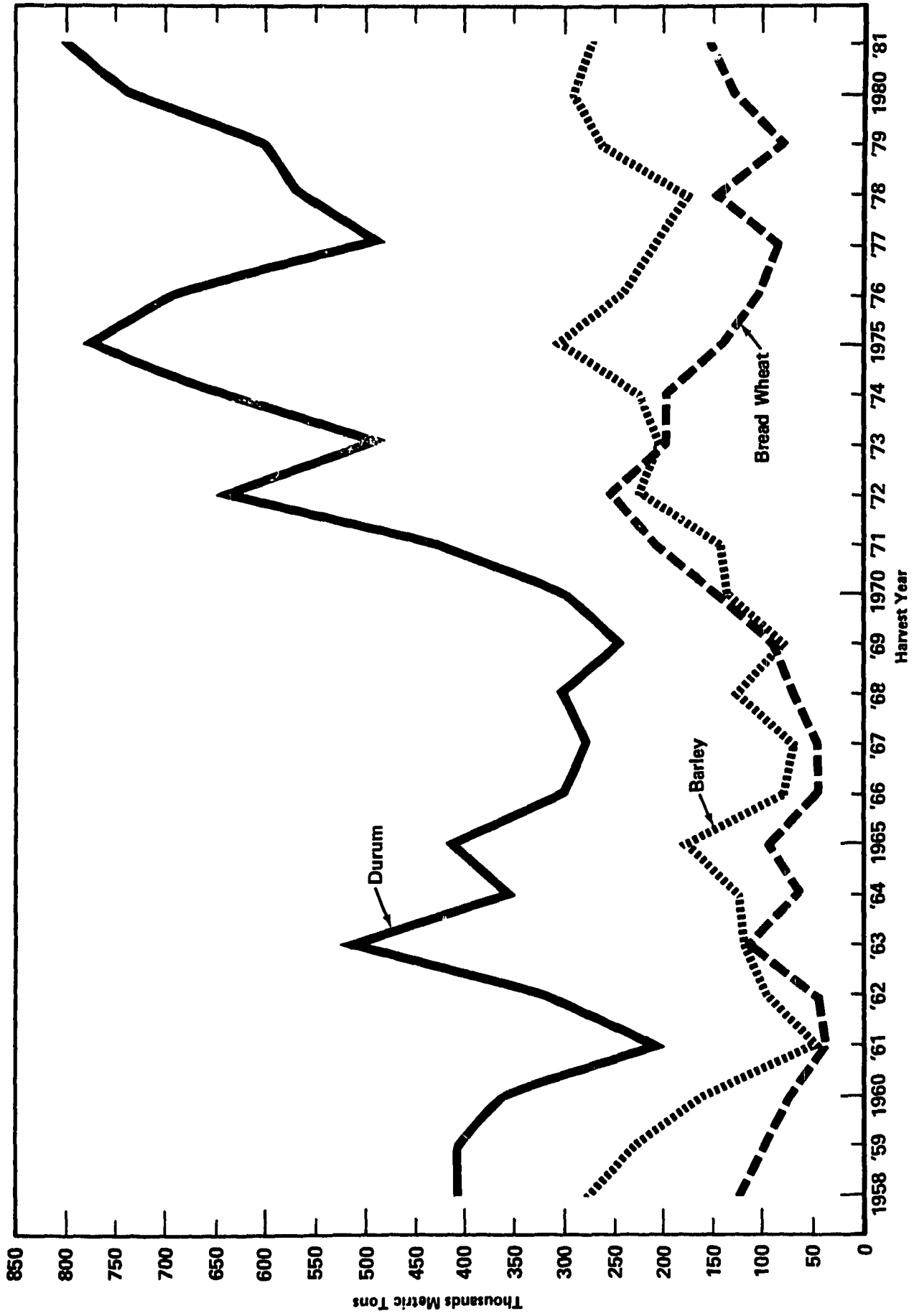
APPENDIX D
FIGURES AND TABLES

APPENDIX D

FIGURES

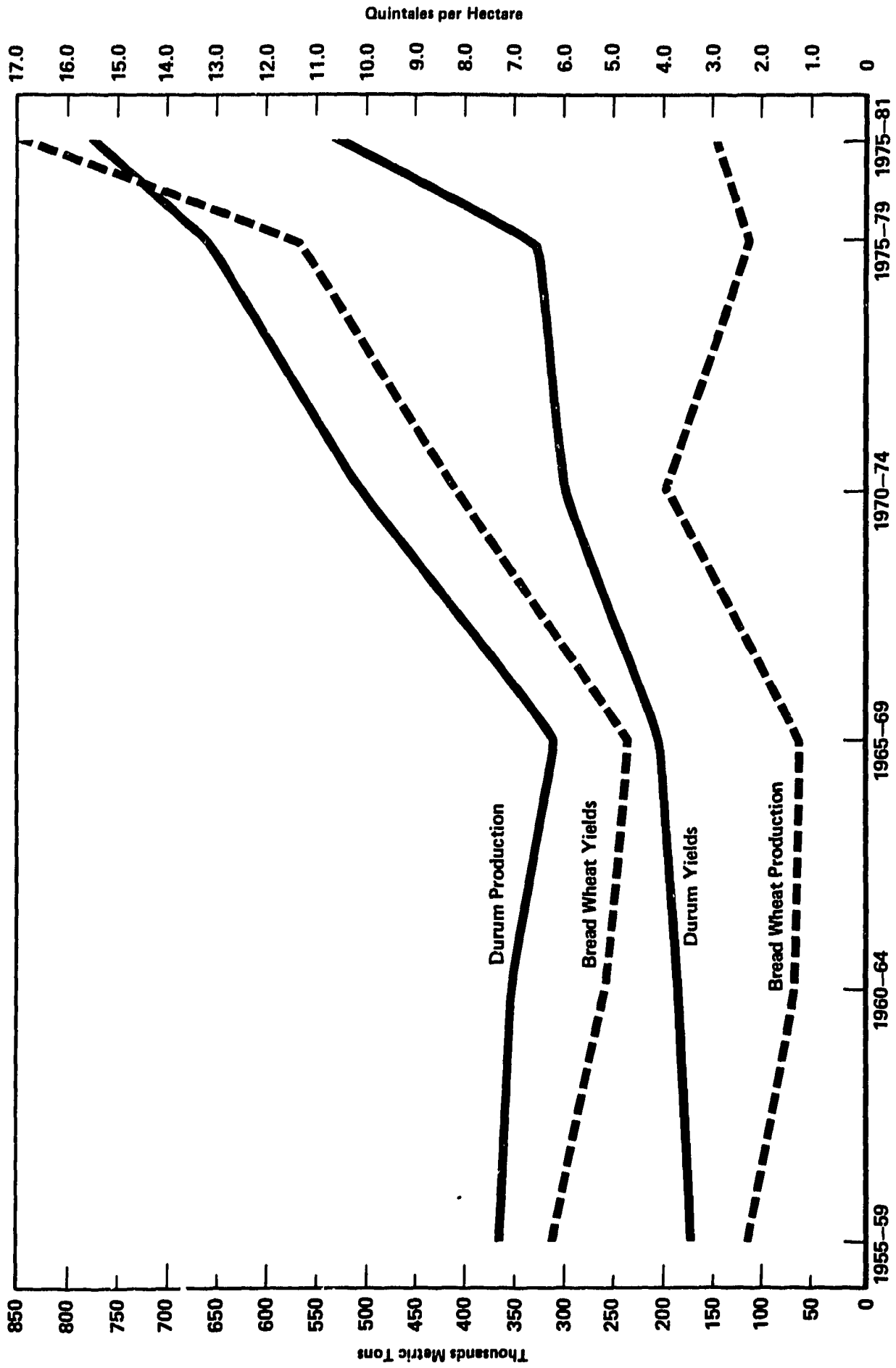
- Figure D-1 Trends in Cereals Production
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Figure D-1: Trends in Cereals Production



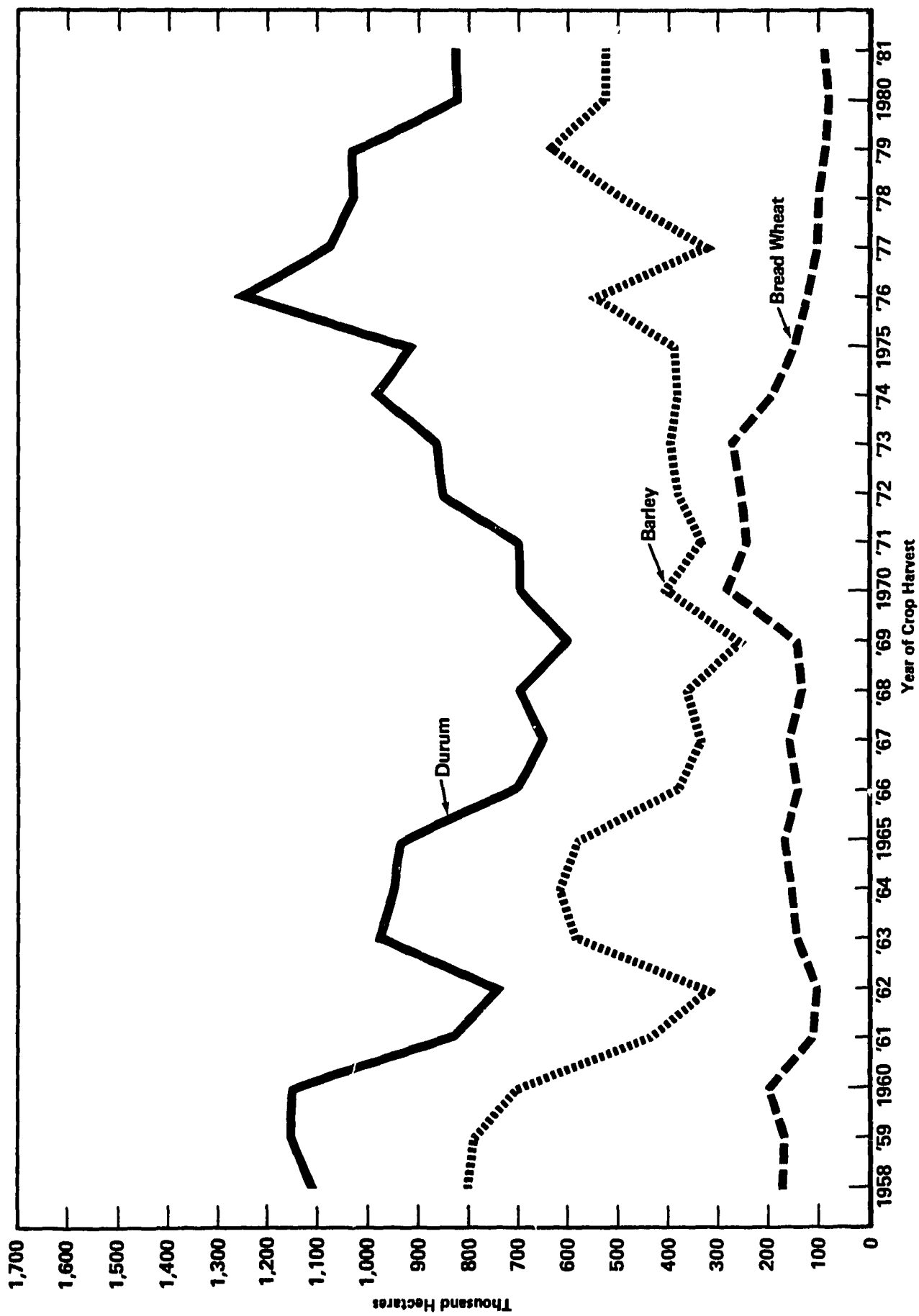
Source: Data from Table D-4.

Figure D-2: Trends in Wheat Production and Yields by Five Year Period



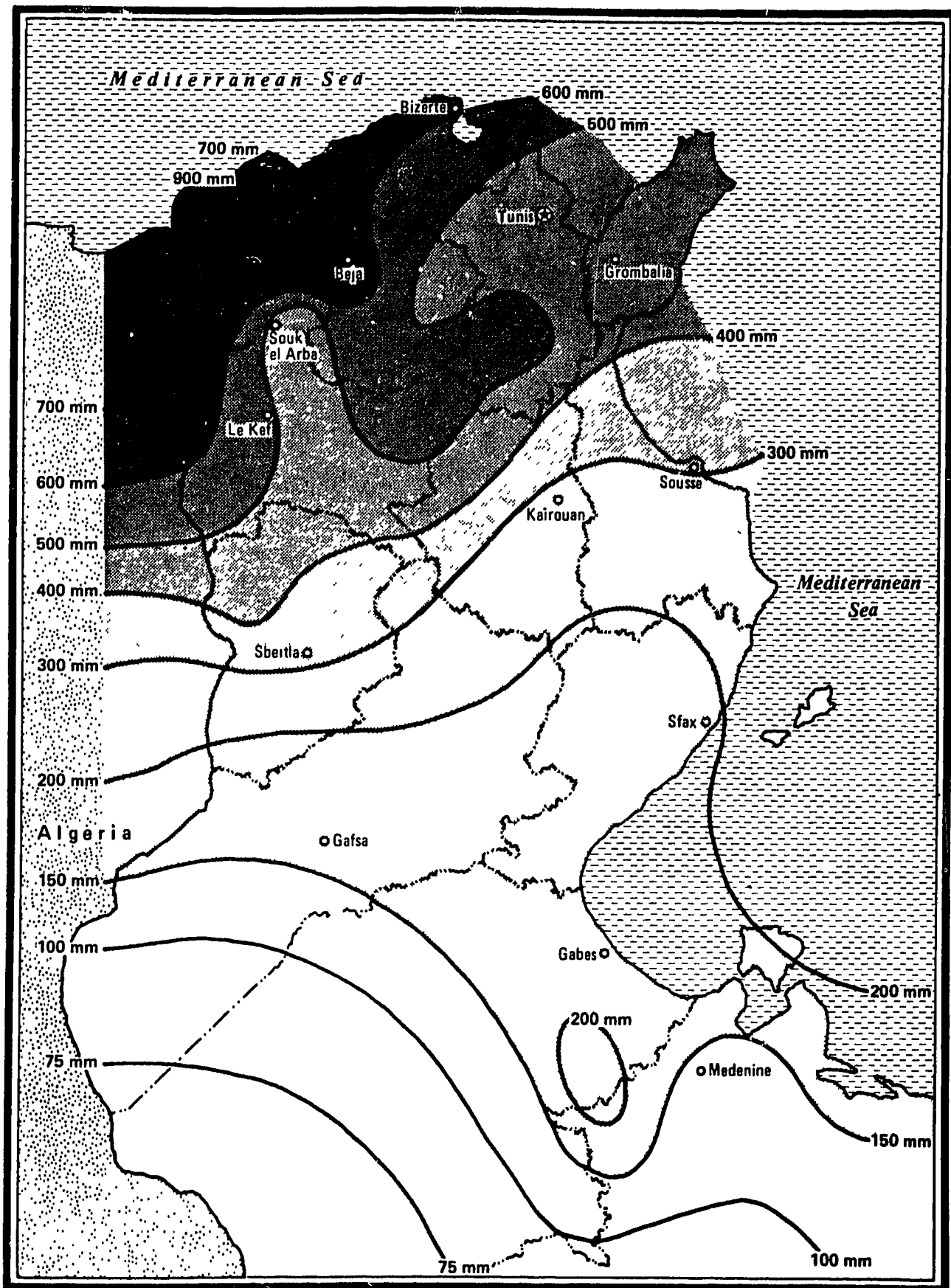
Source: Data from Table D-4 and D-5.

Figure D-3: Trends in Areas of Cereals Harvested



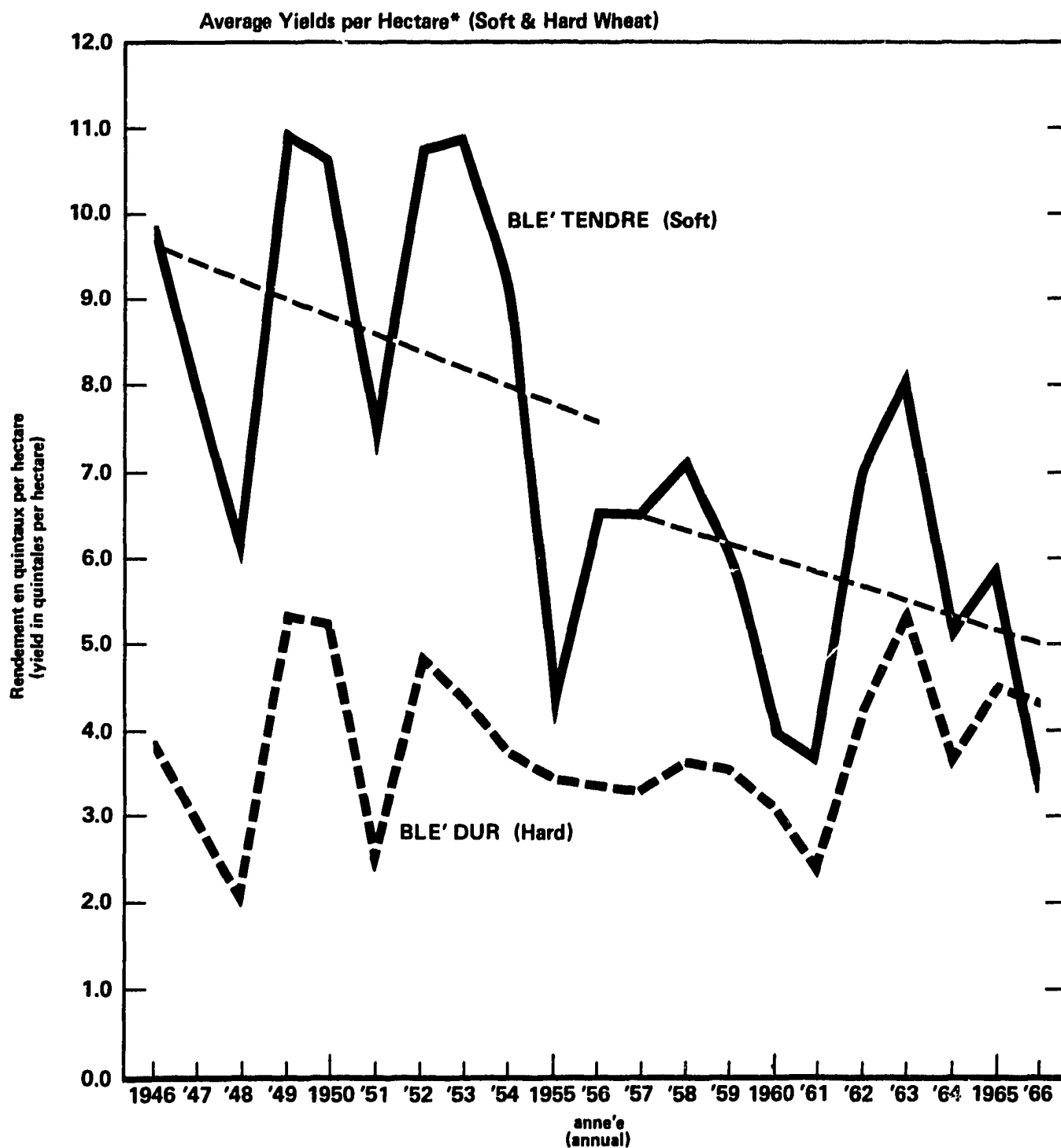
Source: Data from Table D-4.

**Figure D-4: Tunisia — Annual Rainfall
(1901 — 1956)**



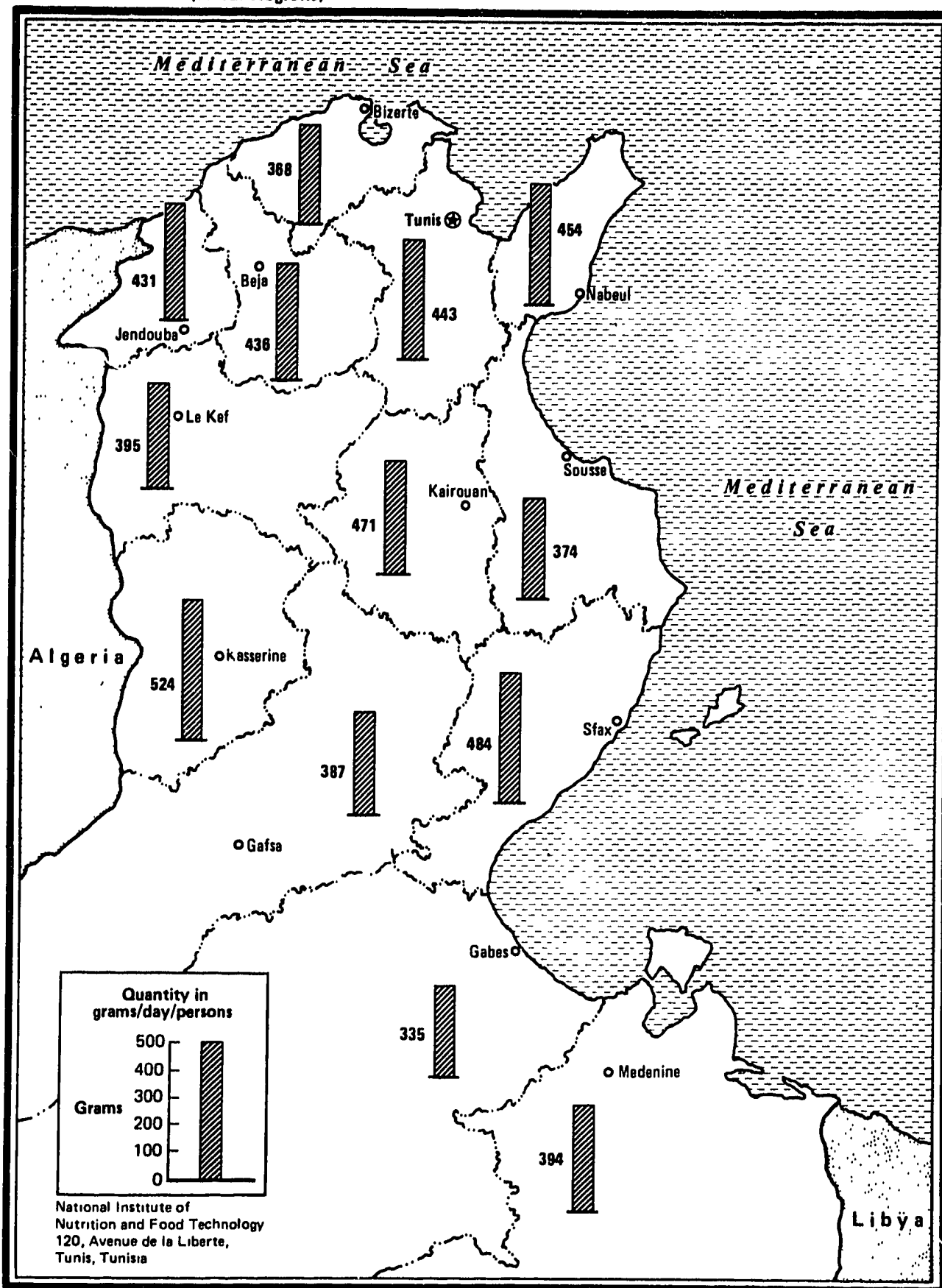
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Figure D—5: Tunisia — Rendement moyen en quintaux par Hectare de ble' dur et ble' tendre -- 1946—1966



*Source: Hyslop, J.D., Dahl, R.P.; Wheat Production in Tunisia: Trends, Variabilities and Prospects, Section of Economic Studies, Directorate of Agricultural Development, Undersecretary of State for Agriculture, Republic of Tunisia and University of Minnesota, September 1968.

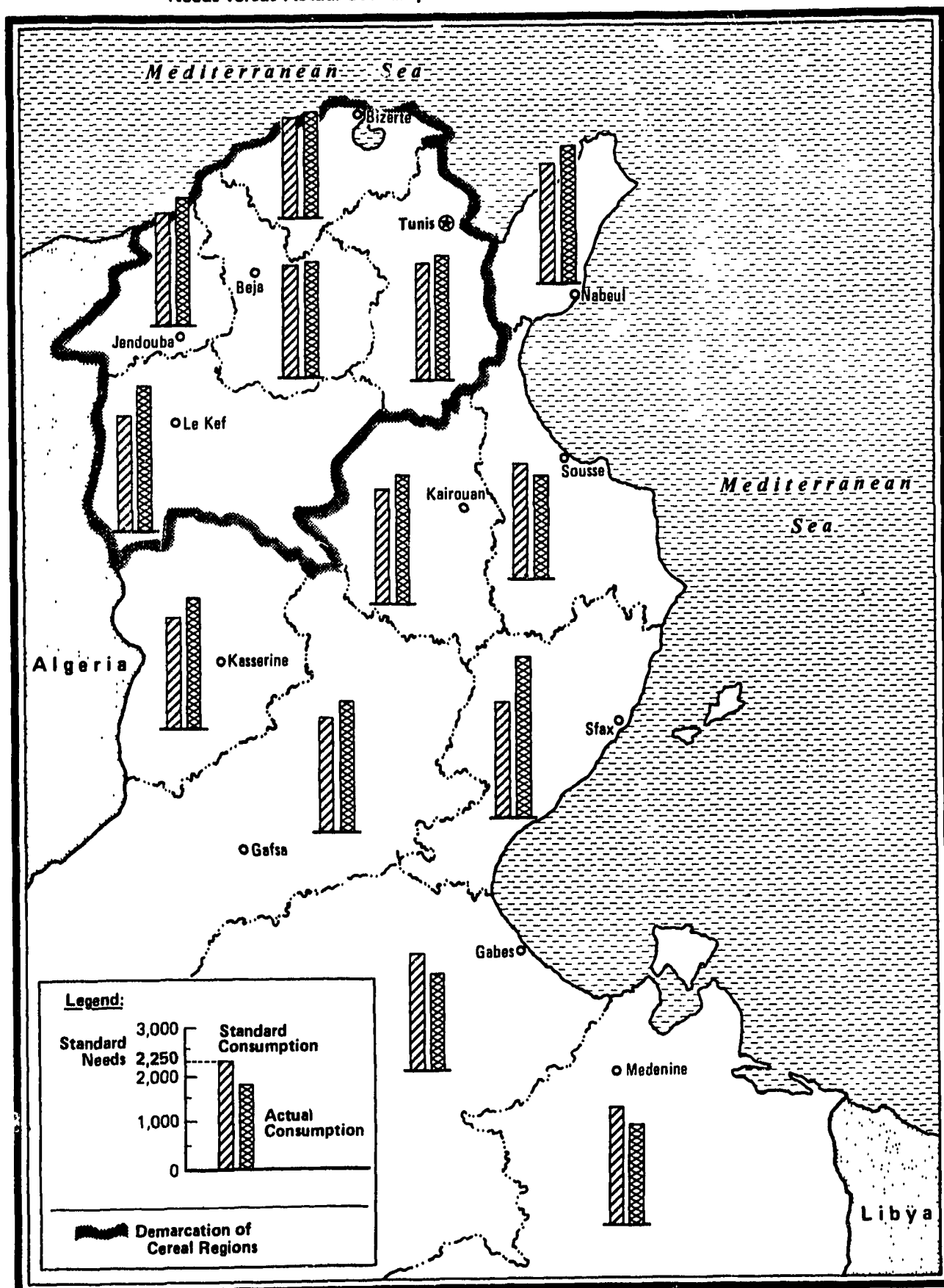
Figure D—6: Consumption of Cereals in Tunisia -- 1968.
(Rural Regions)



Source: Draft — "National Institute of Nutrition" — Tunis.

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Figure D-7: Calories in Tunisia -- 1968
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Source: Draft - "National Institute of Nutrition" - Tunis.

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Table D-1AREAS IN CEREALS
(1,000 hectares)

Crop Year	Durum	Bread Wheat	Barley	Total
1957-58	1,108	174	805	2,087
1958-59	1,153	175	790	2,118
1959-60	1,154	198	705	2,057
1960-61	829	113	427	1,369
1961-62	747	103	319	1,169
1962-63	979	152	588	1,719
1963-64	949	160	616	1,725
1964-65	938	169	583	1,690
1965-66	699	145	377	1,221
1966-67	653	166	338	1,157
1967-68	700	133	365	1,198
1968-69	600	145	250	995
1969-70	700	280	410	1,390
1970-71	692	248	339	1,279
1971-72	862	260	385	1,507
1972-73	866	275	400	1,541
1973-74	991	195	384	1,570
1974-75	917	149	387	1,453
1975-76	1,266	126	576	1,968
1976-77	1,079	105	311	1,495
1977-78	1,032	101	497	1,630
1978-79	1,046	88	642	1,776
1979-80	818	80	533	1,431
1980-81	822	94	529	1,445

Source: Ministère de l'Agriculture, Direction de la Planification des Statistiques et des Analyses Economiques.

Table D-2PRICE OF CEREALS, 1970-1981
(dinars per quintal)

Year	Durum Wheat	Soft Wheat	Barley
1970	4.800	4.300	2.800
1971	4.800	4.300	2.800
1972	4.800	4.300	2.800
1973	4.800	4.300	2.800
1974	6.100	5.500	4.000
1975	6.600	6.000	4.500
1976			
1977	7.135	6.535	5.035
1978	7.600	7.000	5.500
1979	7.600	7.000	5.500
1980	8.600	7.000	5.900
1981	9.600	8.700	6.900
1982	11.000	10.000	8.000

1 Quintal = 100 Kg. = 0.1 m.t.

Sources: Report of Subcommittee for Major Field Crops for the Ministry of Agriculture, and Report of Evaluation of Performance in the Agricultural Sector, 1970-1979, Ministry of Agriculture, 1980.

TABLE D-3 SUPERFICIES ET PRODUCTIONS (Surface & Production)

Year	HARD WHEAT			SOFT WHEAT			BARLEY		
	Surface (Hectares)	Production (Metric Tons)	Commercialisation (Metric Tons)	Surface (Hectares)	Production (Metric Tons)	Commercialisation (Metric Tons)	Surface (Hectares)	Production (Metric Tons)	Commercialisation (Metric Tons)
1921	481,800	1,075,000	--	52,000	348,000	--	375,000	930,000	--
1922	370,030	2,098,000	--	37,000	340,000	--	497,800	2,500,000	--
1923	593,900	800,000	--	40,000	200,000	--	296,850	800,000	--
1924	599,000	2,350,000	--	51,000	350,000	--	490,600	2,500,000	--
1925	433,570	1,040,000	--	51,000	360,000	--	301,750	900,000	--
1926	589,700	2,500,000	--	68,000	700,000	--	503,800	1,500,000	--
1927	671,700	2,900,000	--	73,000	650,000	--	570,300	1,920,000	--
1928	499,440	1,760,000	--	58,000	450,000	--	346,300	895,000	--
1929	741,400	3,230,000	--	76,000	500,000	--	590,300	2,700,000	--
1930	636,760	2,650,000	--	64,000	700,000	--	304,900	2,500,000	--
1931	700,000	2,030,000	--	70,000	800,000	--	486,500	1,200,000	--
1932	720,000	2,700,000	--	80,000	1,100,000	--	495,000	1,800,000	--
1933	835,000	3,400,000	--	55,000	1,350,000	--	610,000	3,400,000	--
1934	600,000	1,700,000	--	110,000	800,000	--	375,000	1,600,000	--
1935	668,000	2,000,000	--	120,000	1,750,000	--	482,000	1,500,000	--
1936	680,000	3,000,000	--	140,000	1,600,000	--	550,000	3,100,000	--
1937	422,800	1,200,000	--	142,000	1,000,000	00	300,000	875,000	--
1938	820,000	2,800,000	1,210,000	152,000	2,000,000	1,589,000	620,000	2,000,000	--
1939	514,000	2,000,000	1,168,000	160,000	1,800,000	1,578,000	307,000	1,100,000	--
1940	747,000	2,900,000	1,198,000	169,000	2,000,000	1,871,000	616,000	3,000,000	--
1941	485,000	1,100,000	582,000	188,000	1,400,000	1,117,000	517,000	1,000,000	--
1942	655,000	2,000,000	1,800,000	154,000	2,100,000	1,873,000	607,000	1,100,000	571,000
1943	742,000	2,100,000	877,000	164,000	1,700,000	1,273,000	350,000	1,100,000	55,000
1944	360,000	1,450,000	292,000	90,000	430,000	255,000	436,800	1,100,000	100,000
1945	639,000	1,105,000	396,000	130,000	815,000	574,000	500,000	1,150,000	239,000
1946	512,000	1,950,000	909,000	131,000	1,300,000	1,100,000	487,000	1,560,000	273,000
1947	467,000	1,400,000	534,000	140,000	1,100,000	858,000	400,000	1,000,000	119,000
1948	710,200	1,510,000	558,000	168,300	1,014,000	602,000	538,000	1,500,000	277,000
1949	668,000	3,600,000	2,027,000	163,000	1,300,000	1,495,000	620,000	4,400,000	3,074,000
1950	528,000	2,800,000	2,205,000	168,000	1,800,000	1,546,000	398,000	2,000,000	1,354,000
1951	835,000	2,000,000	1,231,000	167,000	1,200,000	902,000	667,000	500,000	126,000
1952	952,000	4,670,000	3,024,000	204,000	2,200,000	1,953,000	741,000	3,380,000	1,585,000
1953	873,000	3,800,000	2,281,000	184,000	2,000,000	1,726,000	577,000	1,800,000	465,000
1954	1,153,000	4,350,000	2,350,000	205,000	1,893,000	1,619,000	881,000	1,700,000	428,000
1955	835,800	2,913,000	1,310,000	189,500	1,035,800	775,000	541,000	805,000	65,000
1956	965,000	3,320,000	1,842,000	223,200	1,458,300	1,169,000	728,000	1,560,000	230,000
1957	1,093,300	2,658,900	1,967,000	201,800	1,315,300	1,087,000	807,800	1,852,000	615,000
1958	1,108,700	4,105,700	2,390,000	170,000	1,155,500	967,000	803,800	2,595,900	1,530,000
1959	1,150,400	4,186,600	2,300,000	175,000	1,037,300	835,000	789,200	2,362,800	1,128,000
1960	1,156,400	3,600,400	1,950,000	198,100	1,249,750	494,000	702,100	1,359,500	195,000
1961	829,600	2,003,000	909,000	112,000	423,900	276,000	427,800	504,000	39,000
1962	745,900	3,210,500	1,843,000	101,900	715,200	526,000	319,000	1,035,000	342,000
1963	977,800	3,285,000	1,181,000	153,750	1,218,300	799,000	589,100	2,607,200	602,000
1964	950,000	3,500,000	1,347,000	160,000	810,000	449,000	614,900	1,300,000	191,000
1965	938,000	4,200,000	2,828,000	169,000	1,000,000	651,000	582,000	1,800,000	376,000
1966	700,000	3,000,000	1,685,000	145,000	490,000	313,000	377,000	800,000	114,000
1967	650,000	2,400,000	1,150,000	165,000	420,000	211,000	335,000	700,000	85,000
1968	700,000	3,100,000	1,235,000	133,000	730,000	447,000	355,000	1,300,000	219,000
1969	600,000	2,200,000	801,000	145,000	800,000	410,000	250,000	800,000	155,000
1970	750,000	3,000,000	1,025,000	280,000	1,500,000	867,000	410,000	1,500,000	266,000
1971	700,000	4,000,000	1,621,000	250,000	2,000,000	1,233,000	350,000	1,400,000	276,000
1972	862,000	6,520,000	2,620,000	260,000	2,620,000	1,061,000	385,000	2,360,000	439,000
1973	865,000	4,900,000	1,870,000	275,000	2,000,000	753,000	400,000	2,100,000	235,000
1974	820,000	5,600,000	2,528,000	250,000	1,950,000	782,000	390,000	2,000,000	258,000
1975	880,000	7,760,000	3,070,000	185,000	2,000,000	696,000	335,000	2,600,000	308,000
1976	930,000	7,235,000	2,570,000	259,000	1,955,000	665,000	429,000	2,300,000	385,000
1977	820,000	4,600,000	1,707,000	270,000	1,140,000	465,000	380,000	950,000	145,000
1978	800,000	5,700,000	2,720,000	220,000	1,550,000	650,000	400,000	800,000	258,000
1979	902,000	4,600,000	1,742,000	240,000	1,600,000	459,000	400,000	2,000,000	471,000
1980	700,000	6,000,000	2,700,000	160,000	1,800,000	830,000	360,000	2,200,000	770,000
1981	821,700	8,043,000	2,917,000	94,300	1,590,000	1,112,000	523,900	2,698,000	715,000

Source: Table provided by M. Gagouri, Agricultural Commissaire, Republique de la Tunisie, Commissariat Regionale de Jendouba pour le Development Agricole, 4-24-1982. This table shows production records before 1956. Table D-4 represents official records after 1956.

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Table D-4CEREAL PRODUCTION
(1,000 metric tons)

<u>Crop Year</u>	<u>Durum</u>	<u>Bread Wheat</u>	<u>Barley</u>	<u>Total Wheat</u>	<u>Total Cereals</u>
1957-58	414.3	124.3	281.7	538.6	820.3
1958-59	418.7	105.7	236.3	524.4	760.7
1959-60	359.9	79.0	136.0	438.9	574.9
1960-61	200.5	42.3	50.4	242.8	293.2
1961-62	321.1	71.6	103.4	392.7	496.1
1962-63	528.6	122.7	260.7	651.3	912.0
1963-64	350.0	71.0	130.0	421.0	551.0
1964-65	421.0	100.0	180.0	521.0	701.0
1965-66	300.0	49.0	80.0	349.0	429.0
1966-67	280.0	50.0	70.0	330.0	400.0
1967-68	310.0	73.0	130.0	383.0	513.0
1968-69	245.0	91.0	81.0	336.0	417.0
1969-70	299.0	150.0	151.0	449.0	600.0
1970-71	427.9	217.8	145.8	645.7	791.0
1971-72	652.0	262.0	236.0	914.0	1,150.0
1972-73	490.0	200.0	212.0	690.0	902.0
1973-74	655.0	202.0	280.0	857.0	1,137.0
1974-75	785.0	146.5	310.1	931.5	1,241.5
1975-76	700.0	110.0	240.0	810.0	1,050.0
1976-77	480.0	90.0	100.0	570.0	670.0
1977-78	570.0	150.0	180.0	720.0	900.0
1978-79	600.0	80.0	270.0	680.0	950.0
1979-80	740.0	129.0	295.8	869.0	1,164.8
1980-81	804.4	159.0	269.9	963.4	1,233.3

Source: Ministère de l'Agriculture, Direction de la Planification des Statistiques et des Analyses Economiques.

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Table 0-5 CEREAL YIELDS
(quintals hectare and bushels/acre)

Crop Year	Durum		Bread Wheat		Barley	
	q/hectare*	bu/acre**	q/hectare*	bu/acre**	q/hectare*	bu/acre**
1950-51	2.0	3.55	7.19	10.64	0.75	1.39
1951-52	4.91	7.27	10.78	15.95	4.59	8.49
1952-53	4.35	6.44	10.87	16.09	3.12	5.77
1953-54	3.77	5.58	9.23	13.66	1.93	3.57
1954-55	3.49	5.17	5.53	8.18	1.49	2.76
1955-56	3.44	5.09	6.51	9.63	2.14	3.96
1956-57	3.34	4.94	6.53	9.66	2.28	4.22
1957-58	3.74	5.54	7.14	8.14	3.50	6.47
1958-59	3.63	5.37	6.04	8.94	2.99	5.53
1959-60	3.12	4.62	3.99	5.90	1.93	3.57
1960-61	2.42	3.58	3.74	5.54	1.18	2.18
1961-62	4.30	6.36	6.95	10.29	3.24	5.99
1962-63	5.40	7.99	8.07	11.94	4.43	8.20
1963-64	3.69	5.46	4.44	6.57	2.11	3.90
1964-65	4.49	6.64	5.92	8.76	3.09	5.72
1965-66	4.29	6.35	3.38	5.00	2.12	3.92
1966-67	4.29	6.35	3.01	4.45	2.07	3.83
1967-68	4.43	6.56	5.49	8.13	3.56	6.59
1968-69	4.08	6.04	6.28	9.29	3.24	5.99
1969-70	4.27	6.32	5.36	7.93	3.68	6.81
1970-71	6.18	9.15	8.78	12.99	4.30	7.96
1971-72	7.56	11.19	10.08	14.92	6.13	11.34
1972-73	5.66	8.38	7.27	10.76	5.30	9.80
1973-74	6.61	9.78	10.36	15.33	5.94	11.01
1974-75	8.60	12.73	9.83	14.55	8.01	14.82
1975-76	5.53	8.18	8.73	12.92	4.17	7.71
1976-77	8.73	12.92	7.50	11.10	6.67	12.34
1977-78	10.00	14.80	16.67	24.67	9.47	17.52
1978-79	6.40	9.47	9.30	13.76	4.44	8.21
1979-80	9.55	14.13	16.54	24.48	7.70	14.28
1980-81	11.60	17.17	16.90	25.00	6.10	11.28

* quintals per hectare

** bushels per hectare

Source: **Ministere de l'Agriculture**, Direction de la Planification
des Statistiques et des Analyses Economiques.

Table D-6

RAINFALL VARIABILITY, 1955-1980

Period	North			Center	South	Center and South Average
	Tunis	Makthar	Average All North	Kasserine	Gafsa	
	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
<u>Crop Year</u> (Sept-May)						
Maximum	877	1152	851	702	299	518
Minimum	311	301	302	195	78	157
Average	454	491	524	267	166	281
<u>Seeding Period</u> (Sept-Dec)						
Maximum %			69			89
Minimum %			29			32
Average %			42			44

Source: Ben Senia, Mohamed, Supply Response of Cereals in Tunisia, abstract of Ph.D Thesis, Iowa State University, Ames, Iowa, 1981.

**Table D-7 NITROGEN AND PHOSPHATE FERTILIZER RECOMMENDATIONS
FOR HIGH-YIELDING (HYV) AND ORDINARY VARIETIES (OV)**

Average Rainfall (mm)	Fertility Level	Nitrogen kg/ha				Total		P2O5 (kg/ha)	
		Seeding Time		Tillering Stage					
		HYVs	OVs	HYVs	OVs	HYVs	OVs	HYVs	OVs
500	High*	45	33	33-45	22	78-90	55	45	45
	Low**	67	33	33-45	33	100-112	66	45	45
400-500	High	33-45	33	22	22	55-67	44	30	30
	Low	45	33	33	22	78	55	30	30
400	High	22-23	22	22	22	45-55	44	30	30
Irrigated		67		67		133		67	

* Wheat crop following well-worked fallow or pulse crop

** Wheat crop following wheat or forage

Source: Progress Report: Tunisia 1973/74
CIMMYT and Technical Division, Office of Cereals
Ministry of Agriculture

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Table D-8 FERTILIZER RECOMMENDATIONS FOR HYVS

AVERAGE ANNUAL RAINFALL mm	CROPPING HISTORY	NITROGEN (N)* IN KILOGRAMS PER HECTARE		PHOSPHORUS* (P205)	
		In Seeded	Top Dressing	Total (N)	
500	wheat after fallow	33	22	55	45
	or legume				
	wheat after wheat	33	33	67	45
	or forage				
400-500	wheat after fallow	22	22	45	33
	or legumes				
	wheat after wheat	33	22	55	33
	or forage				
400	-	22	22	45	33

* Nitrogen to be applied as ammonium nitrate (33.5%) and Phosphorous as triple superphosphate (45% P205)

Source: Resume des Activites 1979-80
Division Technique (Projet Ble)
Office des Cereales

Table D-9 New Varieties Developed

Durum	Year of Release	Maximum Yield* Potential (mt/ha)	Per Hectare
(D-117 Best Traditional Variety)		2.0	20
INRAT 69 (D-5825)	1969	3.5	35
Amal	1972	4.0	4.0
Bedri	1972	4.0	40
Maghrebi	1974	5.5	55
Ben Bachir	1980	6.0	60
Kareme	1981	6.5	65
<u>Bread Wheat</u>			
Florence Aurore	1930	3.5	35
Soltane**	1972	4.5	45
Carthage	1974	6.0	60
Dougga	1974	6.0	60
Fath	1974	5.5	55
Salambo	1981	6.5	65
Tanit	1981	6.5	65

* Potential yield figures were provided by Dr. W. McCuistion, former CYMMIT Plant Breeder. These are yields on small plots under optimum conditions including adequate soil moisture, plant nutrients, weed control and good seed bed preparation.

** Now removed from official list because of susceptibility to stripe rust.

Source: 'Resume des Activites: 1979-1980, Division Technique, Projet Ble',
Office des Cereales.

Table D-10 PARTICIPANTS TRAINED AT THE GRADUATE LEVEL*

<u>Name of Participant</u>	<u>Degree/University</u>	<u>Specialization</u>	<u>Present Location</u>
DAALOU, Abderrazak	Ph.D. Oregon State	Plant Breeding	INAT ¹
KETATA, Habib	Ph.D. Oklahoma State	Crop Science	INAT
MEKNI, Mohamed Salah	Ph.D. University of Maine	Agronomy	ICARDA ² , Syria
CHEMLI, Mohamed	M.S. Oregon State	Agronomy	Yemen
DHIF, Khemais	M.S. Texas A&M	Agricultural Extension	Director of Rural Development, Kairouan
DRISS, Najah	M.S. University of Montana	Agronomy	Secrétaire General de Governorat, Tunis
GAIB, Mohamed	M.S. Colorado State	Extension Education	FAO (country unknown)
GARGOURI, Taib	M.S. University of Idaho	Plant Science	Regional Development Office, Jendouba
GODANE, Allala	M.S. Oregon State	Plant Pathology	Cereals Office
HALILA, Mohamed Habib	M.S. Utah State	Grain Legumes	INRAT
MEDDEB, Abelaziz	M.S. University of Arizona	Agronomy	IBRD, (World Bank), Morocco
KHANFIR, Habib	M.S. New Mexico State	Agricultural Economics	UCP ³ , Ministry of Agriculture
BENZBIBA, Mouldi	M.S. University of Montana	Agronomy	Director, Regional Office, OMWVM, Beja
GHANMI, Mouldi	M.S. Mississippi State	Agronomy	Seed Production & Testing Division Ministry of Agriculture
BOUSLAMA, Mohamed	M.S. Michigan State	Agronomy	In U.S. for Ph.D. under ATT ⁴
HARRABI, Moncef	Ph.D. Montana State	Plant Genetics	INAT
SAAD, Ratiba	M.S. University of Arizona	Soil Science	Continued independently financed Ph.D. Did not return to Tunisia
TAIB, Mansour	M.S. Oklahoma State	Agronomy	Regional Director, Livestock Office, South Tunisia
DAHMANE, Ali ⁵	Ph.D. in Australia	Grain Legumes	INAT

1 Institut National Agronomique de Tunisie.

2 International Center for Dryland Agricultural Research.

3 Unite Cooperative de Production.

4. Agricultural Technology Transfer Project.

5. Trained in Australia under Ford Foundation grant.

Source: USAID records updated by personal interviews with returned participants.

Table D-10-a

Staffing of the Technical Division, Office of Cereals, 1982

<u>Section</u>	<u>Number of Personnel</u>		
	<u>B.S.</u>	<u>2 yrs of College</u>	<u>High School</u>
Genetics	1	3	1
Experimentation	2	1	2
Crop Rotations	1	1	1
Legumes	1	4	1
Extension	?	5	13
Fertilization	1	4	2
Phytopathology	0	0	3
Totals	<u>6</u>	<u>18</u>	<u>23</u>

Table D-11

Area Planted in Cereals, 1978 - 1981

Type Cereal	1978	1979	1980	1981
Durum Wheat ordinary	820	828	559	532
Durum Wheat HYV	212	218	259	289
Bread Wheat ordinary	61	57	28	30
Bread Wheat HYV	40	31	57	64
Barley	497	642	413	530
TOTALS	1,630	1,776	1,316	1,445

Table D-11a

Evolution of Production of Cereals, 1978 - 1979

(in metric tons)

Type Cereal	1978	1979	1980	1981
Durum Wheat	650	600	740	804.4
Bread Wheat	100	80	129	159.0
Barley	200	270	296	269.9
TOTALS	950	950	1,165	1,233.3

Table D-11b

Yields of Cereals, 1978 - 1979

(in metric tons and quintals per hectare)

Type Cereal	1978		1979		1980		1981	
	M.T.	Qn.	M.T.	Qn.	M.T.	Qn.	M.T.	Qn.
Durum Wheat	0.63	6.3	0.57	5.7	0.90	9.0	0.98	9.8
Bread Wheat	0.99	9.9	0.91	9.1	1.61	16.1	1.69	16.9
Barley	0.40	4.0	0.42	4.2	0.72	7.2	0.51	5.1

Source: Ministry of Agriculture, Republic of Tunisia, Economic Budget 1982, Agriculture and Fisheries, Bureau of Planning, Statistics, and Economic Analysis, 1982.

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TABLE D-12
UTILIZATION OF FERTILIZER AND HERBICIDES ON CEREALS, 1968-1981

Crop Year	Ammonium Nitrate (mt of N)	Phosphate* (mt of p ₂ O ₅)	Herbicides (area treated - hectares)
1968-69	4,800	-	
1969-70	5,640	-	
1970-71	7,919	-	100,000 approximately
1971-72	11,055	18,971	100,000 approximately
1972-73	13,400	14,100	100,000 approximately
1973-74	14,405	15,600	135,000
1974-75	9,100	11,700	144,000
1975-76	12,100	8,600	212,000
1976-77	10,800	8,750	NA
1977-78	6,030	7,800	128,000
1978-79	11,390	10,985	100,000
1979-80	13,400	17,680	97,500
1980-81	18,425	20,400	184,600
1981-82	21,105	24,900	234,900

*Phosphatic fertilizers used are Triple Superphosphate (45% P₂O₅) and Simple Superphosphate (16% P₂O₅).

Source: Budget Economique, for Years 1977-78 to 1981-82; for earlier years: Progress Report, Tunisia 1973-74 CIMMYT and Technical Division, Office of Cereals.

Table D-13
TOTAL USE OF FERTILIZERS IN TUNISIA, 1967-1979

<u>Fertilizer Year</u>	<u>Triple Super- Phosphate (45)</u>	<u>Simple Super- Phosphate (16)</u>	<u>Phosphate*</u>	<u>Ammonium Nitrate</u>	<u>Nitrogen*</u>
1967-68	21,440	32,200	14,200	20,000	6,600
68-69	30,000	29,900	18,300	24,000	7,900
69-70	25,000	33,800	16,600	30,000	9,900 (1)
70-71	33,000	35,000	20,600	40,000	13,200
71-72	25,000	30,000	16,000	60,000	19,800
<hr/>					
72-73	28,049	39,459	18,900	40,650	13,400
73-74	28,049	43,514	19,500	69,919	23,200
74-75	33,658	40,000	21,500	64,065	21,100 (2)
<hr/>					
75-76	23,340	51,903	18,800	58,836	19,400
76-77	27,246	44,646	19,500	52,493	17,300
77-78	26,112	53,373	20,300	46,244	15,200 (3)
78-79	29,168	50,884	21,200	48,423	16,000
CY 1980 (E)**	44,114	58,687	29,241	70,936	23,400

Note: *Nutrient equivalent of the compounds listed.

**E = Estimated

Sources: (1) P.A.V.
(2) Quadrannual Plan
(3) Division Technique "Office des Cereals"

Source: Newburg, Richard, Multiyear Proposal, Program Paper, Tunisia, PL 480, Title I, USAID/Tunis, March 1981, Tunisia.

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Table D-14 SUMMARY OF PRESENT LOCATION OF DEGREE PARTICIPANTS*

	<u>Numbers</u>	<u>Percent</u>
Teaching and cereals research at INAT	4	58
Assigned to INRAT	1	
Working in extension, or position which directly contributes to cereals production	5	
In jobs unrelated to cereals	2	10
Returned to U.S. for further study**	1	5
Working in other countries	<u>5</u>	<u>26</u>
Total	19	99***

* Including Ford Foundation-funded participant.

** One participant returned to the U.S. under Agricultural Technology Transfer Project and is studying for a Ph.D. degree in Agronomy.

*** Does not add because of rounding.

Table D-15 TRENDS IN CEREAL PRODUCTION AND RAINFALL
FIVE YEAR AVERAGES, 1955-1979

	<u>1955-59</u>	<u>1960-64</u>	<u>1965-69</u>	<u>1970-74</u>	<u>1975-79</u>	<u>Growth Rate Percent</u>
<u>Durum</u>						
Hectares 1000	1,031	932	738	832	987	-0.2
Yield Q/ha ^a	3.53	3.79	4.21	6.07	6.61	3.1
Production 1000 t	364	353	311	505	653	2.9
<u>Bread Wheat</u>						
Hectares 1000	192	145	152	252	109	-2.8
Yield Q/ha	6.36	5.33	4.79	8.20	11.25	2.8
Production 1000 t	122	77	73	206	123	-
<u>Barley</u>						
Hectares 1000	734	531	382	384	478	-2.1
Yield Q/ha	2.56	2.56	2.83	5.07	4.72	3.1
Production 1000 t	188	136	108	195	225	0.9
<u>All Cereals</u>						
Hectares 1000	1,957	1,608	1,272	1,468	1,574	-1.1
Yield Q/ha	3.44	3.52	3.87	6.17	6.36	3.1
Production 1000 t	674	566	492	906	1,001	2.0
<u>Rainfall^b</u>						
North mm/yr.	580	530	450	560	500	-
Center and South mm/yr.	292	260	256	341	280	-

a quintals per hectare. One quintal equals 100 kg or 220 pounds.

b The north accounts for more than half the arable land and produces 62.68 and 39 percent of the total acreage of durum and bread wheat, respectively. Rainfall ranges from 400-600 mm/yr. The Center accounts for about 40 percent of the arable land and produces 35-40 percent of the acreage of all cereals. Rainfall ranges from 250-350 mm/yr. The south accounts for only 5-10 percent of the arable land representing the area in cereals. Rainfall averages less than 250 mm per year.

Source: Mohamed Ben Senia, Supply Response of Cereals in Tunisia, Ph.D. Thesis, Iowa State University, 1981

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TABLE D-16 CEREALS HARVESTED IN 1981

(1,000 hectares)

		D U R U M		B R E A D W H E A T						
		:	:	:	:	:	:			
GOUVERNORAT	:	HYV	:	OV	:	TOTAL	:	BARLEY	:	Total
Tunis	:	:	:	:	:	:	:	:	:	: All Cereals
	:	:	:	:	:	:	:	:	:	:
Zaghuan	:	40.5	:	5.3	:	45.8	:	18.1	:	35.1
	:	:	:	:	:	:	:	:	:	99.0
Dizerte	:	46.2	:	13.0	:	59.2	:	:	:	10.1
	:	:	:	:	:	:	:	:	:	78.7
Rnbeul	:	1.8	:	14.2	:	12.1	:	:	:	16.4
	:	:	:	:	:	:	:	:	:	30.9
North-										
Total:East	:	88.5	:	32.5	:	121.0	:	:	:	63.8
	:	:	:	:	:	:	:	:	:	216.7
Rejaï	:	71.0	:	9.5	:	80.5	:	:	:	11.9
	:	:	:	:	:	:	:	:	:	105.5
Jendouba	:	33.6	:	26.7	:	60.3	:	:	:	16.0
	:	:	:	:	:	:	:	:	:	82.9
Silliana	:	77.3	:	29.3	:	106.6	:	:	:	25.6
	:	:	:	:	:	:	:	:	:	152.6
Le Kef	:	15.0	:	111.9	:	126.9	:	:	:	52.3
	:	:	:	:	:	:	:	:	:	184.3
Total:NorthWest:	:	196.9	:	177.4	:	374.3	:	38.7	:	6.5
	:	:	:	:	:	:	:	:	:	105.8
Total: North	:	285.4	:	209.9	:	495.3	:	63.5	:	13.6
	:	:	:	:	:	:	:	:	:	77.1
Central										
Total: & South	:	1.2	:	198.6	:	199.8	:	:	:	11.0
	:	:	:	:	:	:	:	:	:	273.4
All										
Total: Tunisia	:	286.6	:	408.5	:	694.9	:	63.5	:	24.6
	:	:	:	:	:	:	:	:	:	88.1
	:	:	:	:	:	:	:	:	:	443.0
	:	:	:	:	:	:	:	:	:	1226.2

Source:

Enquete Par Mesure Objective Sur les Rendements des Céréales, 1981
Ministère de l'Agriculture

Direction de la Planification des Statistiques et des Analyses Economiques

TABLE D-17 AVERAGE YIELDS OF CEREALS ON AREA HARVESTED
(QUINTALS/HECTARE*)

In 1981 D U R U M				BREAD WHEAT			
GOUVERNORAT	: HYV	: OV	: TOTAL	: HYV	: OV	: TOTAL	: BARLEY
Tunis	:	:	: 15.3	:	:	: 15.7	: 12.4
Zaghouan	: 11.3	: 8.4	: 11.0	:	:	: 14.2	: 11.8
Bizerte	: 17.8	: 13.4	: 16.8	:	:	: 24.4	: 11.7
Nabeul	:	:	: 11.6	:	:	: 10.7	: 8.6
Average North							
East	: 14.9	: 11.8	: 14.0	: 18.4	: 12.2	: 17.0	: 11.0
Beja	: 22.7	: 18.8	: 22.2	:	:	: 28.3	: 14.0
Jendouba	: 23.0	: 17.7	: 20.7	:	:	: 27.4	: 12.4
Siliana	: 14.0	: 10.6	: 13.1	:	:	: 18.6	: 12.7
Le Kef	: 10.8	: 9.0	: 9.2	:	:	: 11.1	: 9.0
NorthWest	: 18.4	: 11.1	: 15.0	: 22.6	: 17.0	: 21.8	: 11.0
North	: 17.3	: 11.2	: 14.7	: 21.0	: 14.5	: 19.8	: 11.0
Center & South	: 9.1	: 3.7	: 3.7	:	: 5.5	: 5.5	: 3.1
All Tunisia	: 17.3	: 7.6	: 11.6	: 21.0	: 10.5	: 18.1	: 6.1

* 1 quintal/hectare = 1.48 bushels of wheat or 1.85 bushels of barley per acre.

Source: Enquete par mesure objective sur les Rendements des Cereals, 1981
Ministere de l'Agriculture, Direction de la Planification des Statistiques
et des Analyses Economiques.

Table D-18

Planned and Actual Land Use and Value of Gross Annual Production in the Agricultural Sector, 1962-1971
(Actual 1959-1961)

<u>Product</u>	<u>Average Area</u> <u>Hectares</u>		<u>Production</u> <u>Metric Tons</u>		<u>Value</u> <u>Dinars^{2/}</u>	
	<u>Actual 1959-61^{1/}</u>	<u>Planned 1971</u>	<u>Actual 1959-61^{1/}</u>	<u>Planned 1971</u>	<u>Actual 1959-61^{1/}</u>	<u>Planned 1971</u>
Cereals	3,387 ^{3/}	2,754 ^{3/}	552	1,147	20.064	41.779
Tree Crops	941	1,379	933	1,289	40.234	65.765
Vegetables	24	50	359	777	10.476	21.929
Pulses	67	160	15	134	774	6.402
Industrial Crops	10	14	37	129	682	1.280
Forages ^{4/}	56	383	1,209	3,249	18.135	48.735
Totals	4,485	4,740	3,105	6,725	90.365	185.890

^{1/} Used average estimates to reduce biases due to weather effects.

^{2/} 1966 prices.

^{3/} Includes fallow, estimated to be 44 percent of the total area allocated to cereals.

^{4/} Includes the production and value of straw and stubble forage from the cereal and pulse crops. For all forages, production was originally estimated in forage units. Conversion to tons was based on the assumption of 300 forage units per ton of forage, an average for hay in Tunisia.

Source: "Retrospective of Tunisia Agriculture: 1962-1971," by Herman Van Wersch and Thomas Daves, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota.

Table D-19

LAND BROUGHT UNDER STATE CONTROL, 1962-1971

	Direct State Management		Cooperative Management				Other	Total
	OTD	OMV	UCP	Coop. de Polycult.	Pre Coop.	thousand hectares		
1964 ¹	700	500	114	87	-		8	1,409
1968 ²	60	206	361	718	526		8	1,879
1969	n.a.	n.a.	2,016	415	546		4	n.a.
(Apr. 30) 1969	n.a.	n.a.	4,110	78	546		3	n.a.
(Aug. 30) 1969	n.a.	n.a.	1,105	126	353		4	n.a.
(Oct. 31) 1971	313	127	208	116	-		-	764

1 End of 1962-1964 plan period.

2 End of 1965-1968 plan period.

Sources:

Retrospective Decennale, 2eme partie, Plan Quadriennal 1969-1972, 2eme partie, Section V: Information Rapides, April, August 1969. Statistiques Trimestrielles, Oct. 1969.

OTD (Office des Terres Domaniales) State Land Office
OMV (Office de Mise en Valeur) Office for Development of the Mejerda Valley

UCP (Unites Cooperatives de Production) Cooperative Production Units

"Retrospective of Tunisian Agriculture: 1962-1971," International Agriculture Series 13, Wersch, Herman Van and Daves, Thomas, Institute of Agriculture, Forestry, and Home Economics, University of Minnesota, 1972.

Table D-20

Types of Ownerships and Farm Sizes

<u>Type Ownership</u>	<u>No. of Farms</u>	<u>Area in 1000 Hectares</u>
<u>Agricultural Land</u>		
A. Private		
1-5 ha.	131,600	304
5-10 ha.	72,300	507
10-20 ha.	63,300	379
20-50 ha.	41,500	1,237
50-100 ha.	8,000	541
100-200 ha.	2,600	372
200-500 ha.	1,150	356
500- ha.	400	271
	-	4,517
B. Public		
Agrocombinates	25	68
Pilot, educational farms	-	48
Northern Co-ops	218	202
Co-ops in Center and South	347	200
To be sold to young farmers	-	112
To be sold at public auction	-	94
Subtotal A + B		5,241
<u>Forests</u>		1,240
<u>Extensive Pastures (Tribal Land)</u>		2,550
	Sub-total (productive land)	9,031
<u>Unuseable Land</u>		6,969
	Total area of country	16,000

Source: Ministry of Agriculture
Jan. 1972

Source: Country Program - "The Local Mutual Credit Union System And Small Farm Credit in Tunisia" by William F. Johnson, Agricultural Economist, USAID/Tunisia, Tunis, December 1972. "Small Farmer Credit in Africa" AID Spring Review of Small Farmer Credit, Volume VI, Feb. 1973, No. SR 106, Country Papers

Table D-21

Size Distribution of Farms in 1980 a/

	Units	0-10 ha	0-20 ha	20-100 ha	Over 100 ha	TOTALS
No. of farmers	1,000 f	225.4	296.0	54.6	4.4	355.0
% of farmers	%	63.5	83.4	15.4	1.2	100.0
Cropland area	1,000 ha	870	1,832	1,847	1,406	5,085
Cropland area %	%	17.1	36.0	36.3	27.6	100.0
Average farm size	ha b/	3.86	6.19	33.83	296.81	14.32
% of area rented c/	%	2.5	3.5	3.8	5.7	4.4
% farmers netting less than 500 dinars of gross revenue d/	%	83.3	84.2	43.1	11.0	74.4
% farmers having another economic activity	%	47.6	43.1	24.7	18.2	40.0
% farmers spending less than 6 months on the farm	%	43.5	38.5	16.7	11.4	34.8

a/ Source: (19).

b/ ha equals about 2.5 acres.

c/ The group of 200-500 rented 17.84 percent of the land they exploited. The percentages are for 1976.

d/ The figures are for 1976, dinar equals about two U.S. dollars.

Source: Ben-Senia, Mohamed; Supply Response of Cereals in Tunisia, Abstract of Ph. D Thesis, Iowa State University, Ames, Iowa.

Table D-22

AVERAGE ANNUAL AREA FOR CEREALS BY FARM SIZE, 1970-1979
WITH ESTIMATED PRODUCTION BASED ON AVERAGE ANNUAL AREA
IN CEREALS OF 1,554,000 HECTARES (1971-1981)

<u>Area in Hectares</u>	<u>Percent of Total</u>	<u>Accumulated Percentage</u>	<u>Area in Cereals*</u>
10	18.2	18.2	283,000
10 - 50	45.3	63.5	704,000
50 - 100	12.5	76.0	194,000
100 - 200	8.2	84.2	128,000
200 - 500	10.7	94.9	166,000
500	5.0	99.9	<u>79,000</u>
TOTAL			1,554,000

*Material derived from production information in Table D-4.

Source: 'Report of Subcommittee for Major Field Crops for the Ministry of Agriculture,' 1980, and 'Report of Evaluation of Achievements in the Agricultural Sector, 1970-1979.'

Table D-23

TECHNICO-ECONOMIC CHARACTERISTICS OF FARMS PER SIZE GROUP IN 1980^{a/}

	Units	0-10 hectares	0-20 hectares	20-100 hectares	Over 100 hectares	All Farms
Average farm size	hectare	3.86	6.19	33.83	296.81	14.32
Average area in cereals ^{b/}	hectare	1.54	2.37	12.54	83.50	4.94
Average area in tree crops ^{c/}	hectare	1.56	2.24	8.94	74.86	4.23
No. farmers owning a tractor	farmers	1,080	1,750	5,720	2,720	10,190
Percent farmers using tractors ^{d/}	percentage	40.0	45.5	73.3	100	50.5
No. of workers per hectare ^{e/}	persons	.66	.45	.13	.04	.20
Nitrogen units per hectare ^{f/}	Kg/hectare	6.3	4.7	2.4	8.4	4.9
Phosphates units per hectare ^{f/}	Kg/hectare	7.3	5.6	3.8	12.2	6.8

a/ Source: (19).

b/ Averages for the period 1976-1979.

c/ The figures are for 1979.

d/ The figures are for 1976. Tractor use refers to use in seed bed preparation at least.

e/ 806,000 males and 415,000 females worked respectively 13 and 15 days in March 1976, date of the survey. Of the total of 1,222,000 workers or about 45 percent of the total labor force, 854,000 were family derived from the simple aggregation of these categories and constitute only a rough measure of labor intensity.

f/ Amounts applied in the period September 1979 to March 1980.

Source: Ben Senia, Mohamed; Supply Response of Cereals in Tunisia, Abstract of Ph.D. Thesis, Iowa State University, Ames, Iowa.

Table D-24

EVOLUTION DES PRIX DES ENGRAIS ET PESTICIDES *
(Evolution of Prices of Fertilizer & Pesticides)

Campagne Produits	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82
1/- Engrais (D/ql)											
• Super 16	1,590	1,590	1,590	1,590	1,590	1,590	1,590	1,590	1,590	1,590	2,600
• Super 45	3,950	4,125	3,600	3,600	3,600	3,600	3,600	3,600	3,600	3,600	4,650
• Sulfate de potasse	5,100	5,180	5,180	9,750	9,750	7,500	8,200	8,200	9,000	10,300	--
• Ammonitrate 35,5 %	3,000	3,000	3,000	3,000	5,000	5,000	5,000	5,000	5,000	5,000	6,450
• Sulfate d'ammonia- que.	2,037	2,037	2,037	2,037	3,297	3,297	3,297	3,297	3,297	3,297	--
2/- Produits de traitement											
• Phosdrin (D/l)	2,350	2,350	2,350	2,350	2,350	2,350	2,350	2,500	2,500	2,500	
• Aldrex (L/kg)	0,200	0,200	0,230	0,230	0,240	0,240	0,200	0,240	0,240	0,240	
• Soufre fleur (D/kg)	8,500	8,500	8,500	8,500	11,769	11,769	11,769	11,769	11,769	11,769	
• Diméthoate (D/l)	2,500	2,500	1,800	1,800	1,800	1,800	1,738	1,560	1,560	1,560	
• Désherbant 2.4.D. (D/l)	0,460	0,460	0,500	0,500	0,500	0,500	0,700	0,870	0,700	0,700	
• Suffix 20 (D/l)	--	--	--	--	--	--	1,225	1,225	1,225	1,225	

* Retail prices to farmers in dinars/quintal.

Source: Rapport, Evolution des Prix des Engrais, Ministry of Agriculture, Bureau for Planning, Statistics, and Economic Analysis, 1981, Republic of Tunisia.

Table D-25

COMPARISON OF CEREAL PRODUCTION, AVERAGE AREA AND YIELDS
DURING PERIODS 1960-1970 AND 1971-1981

	<u>1960-1970</u>	<u>1971-1981</u>	<u>DIFFERENCE</u>
<u>DURUM</u>			
Total Production (mt 1,000)	3,165	6,905	= +3,290
Average Annual Hectares (1,000)	813	945	= +132
Average Annual Production (mt 1,000)	329	628	= +299
Average Annual Yield (mt/ha)	0.405	0.660	= +0.260
<u>BREAD WHEAT</u>			
Total Production (mt 1,000)	899	1,746	= +847
Average Annual Hectares (1,000)	160	156	= -4
Average Annual Production (mt 1,000)	82	159	= +77
Average Annual Yield (mt/ha)	0.513	1.02	= +0.51
<u>TOTAL WHEAT</u>			
Total Production (mt 1,000)	4,514	8,651	= +4,137
Average Annual Hectares (1,000)	973	1,101	= +128
Average Annual Production (mt 1,000)	411	787	= +376
Average Annual Yield (mt/ha)	0.422	0.715	= 0.293
<u>BARLEY</u>			
Total Production (mt 1,000)	1,373	2,538	= +1,165
Average Annual Hectares (1,000)	453	453	= -0-
Average Annual Production (mt 1,000)	125	231	= +106
Average Annual Yield (mt/ha)	0.276	0.510	= +.234
<u>TOTAL CEREALS</u>			
Total Production (mt 1,000)	5,887	11,189	= +5,302
Average Annual Hectares (1,000)	1,426	1,554	= +128
Average Annual Production (mt/ha)	535	1,017	= +482

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Table D-26

COMPARISON OF AVERAGE ANNUAL CEREAL PRODUCTION, AREA AND YIELDS
DURING PERIODS 1971-1981 AND 1978-1981

	<u>1971-1981</u>	<u>1978-1981</u>	<u>DIFFERENCE</u>
<u>DURUM</u>			
Total Production (mt 1,000)	(6,905)	(2,714)	
Average Annual Hectares (1,000)	945	930	= -15
Average Annual Production (mt 1,000)	628	679	= +51
Average Annual Yield (mt/ha)	0.66	0.730	= +0.07
<u>BREAD WHEAT</u>			
Total Production (mt 1,000)	(1,746)	(518)	
Average Annual Hectares (1,000)	156	91	= -65
Average Annual Production (mt 1,000)	82	159	= -42
Average Annual Yield (mt/ha)	0.513	1.02	= +0.271
<u>BARLEY</u>			
Total Production (mt 1,000)	(2,538)	(1,016)	
Average Annual Hectares (1,000)	453	550	= +97
Average Annual Production (mt 1,000)	231	254	= +21
Average Annual Yield (mt/ha)	0.510	0.46	= -0.05
<u>TOTAL CEREALS</u>			
Total Production (mt 1,000)	(5,302)	(4,248)	
Average Annual Hectares (1,000)	1,426	1,554	= +17
Average Annual Production (mt/ha.)	1,017	1,062	= +444

Table D-27

Area Planted in High-Yielding Varieties 1979-1982
(1,000 Hectares)

Cereal Type	1979	1980	1981	1982
Durum Wheat HYV	218	259	289	330
Soft Wheat HYV	31	52	64	75

Table D-27a

Consumption of Fertilizer for Cereals 1978-1981
(1,000 Metric Tons)

Fertilizer	1978	1979	1980	1981
Super-Phosphate 16%	13	35	15	15
Super-Phosphate 45%	31	30	40	50
Ammonium Nitrate 33%	34	40	55	63

Table D-27b

Use of Herbicide for Weed Control
(Area in Hectares)

<u>1977-78</u>	<u>1978-79</u>	<u>1979-80</u>	<u>1980-81</u>
100	98	185	235

Source: Ministry of Agriculture, Republic of Tunisia, Economic Budget 1982, Agriculture and Fisheries, Bureau of Planning, Statistics, and Economic Analysis, 1982.

Table D-28

AGRICULTURAL CREDIT
BANQUE NATIONALE DE TUNISIE

Yearly Agricultural Lending Operations (Loans Approved)
(In 1,000 Dinars)

	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>Total</u>
<u>Short Term</u>								
Individual	1,687	1,660	1,326	1,148	963	2,217	2,431	11,432
Cooperatives	<u>2,853</u>	<u>2,561</u>	<u>5,377</u>	<u>6,375</u>	<u>6,602</u>	<u>4,630</u>	<u>857</u>	<u>29,255</u>
Subtotal	4,540	4,221	6,703	7,523	7,565	6,847	3,288	40,087
<u>Medium & Long Term</u>								
Individual	361	830	455	491	255	1,846	2,695	6,903
Cooperatives	<u>1,708</u>	<u>1,831</u>	<u>2,571</u>	<u>5,624</u>	<u>2,988</u>	<u>2,878</u>	<u>1,449</u>	<u>19,049</u>
Subtotal	<u>2,069</u>	<u>2,661</u>	<u>3,026</u>	<u>6,115</u>	<u>3,213</u>	<u>4,724</u>	<u>4,144</u>	<u>25,952</u>
Total	<u>6,609</u>	<u>6,882</u>	<u>9,729</u>	<u>13,638</u>	<u>10,778</u>	<u>11,571</u>	<u>7,432</u>	<u>66,639</u>

Source: Johnson, William F.; Agricultural Sector Paper, Annex to Agricultural Development Loan Paper, Fiscal Year 1972, USAID - Tunis, Feb. 18, 1972.

Table D-29
AGRICULTURAL CREDIT, 1979-1980

Agricultural Credit			U: 1.000 Dinars	
	<u>1979</u>	<u>1980</u>	<u>Variation</u> <u>Amount</u>	<u>Percent</u>
Short Term	12.095	18.397	6.302	52.1
Medium Term	<u>1.308</u>	<u>3.254</u>	<u>1.946</u>	<u>148.1</u>
Total	13.403	21.651	8.248	61.5
Short Term	1.528	2.007	479	31.3
Medium and Long Term	<u>13.667</u>	<u>15.959</u>	<u>2.292</u>	<u>16.8</u>
Total	15.195	17.966	2.771	18.2
Total Short Term	13.623	20.404	6.781	49.8
Total Medium and Long Term	<u>14.975</u>	<u>19.213</u>	<u>4.238</u>	<u>28.3</u>
Total Credit	28.598	39.617	11.019	38.5

Source: National Bank of Tunisia, Annual Report 1980.

Table D-30
Budget of a Farm in the Agricultural Credit Program in Northeast

Record of Previous Year (1979-80)

<u>Crop</u>	<u>Areas Hectares</u>	<u>Yield Per Hectare</u>		<u>Total Production</u>	
		<u>quintals</u>	<u>mt</u>	<u>quintals</u>	<u>mt</u>
Wheat	4	7	0.7	28	2.8
Barley	6	9	0.9	54	5.4
Horsebeans	0.5	4	0.4	2	0.2
Chick-peas	0.5	4	0.4	2	0.2

Expenses of Current Year (1980-81)

<u>Crop</u>	<u>Areas Hectares</u>	<u>Yield Per Hectare</u>		<u>Increase</u>	
		<u>quintals</u>	<u>mt</u>	<u>quintals</u>	<u>mt</u>
Wheat	4	15.9	1.59	8	0.8
Barley	6	17	1.70	17	0.8
Horsebeans	0.5	10	1	6	0.6
Chick-peas	0.5	10	1	6	0.6

Expenses (1981 Crop Year)

Cost in Tunisian Dinars

Seed and Plants	TD 66
Fertilizer	71
Pesticides	20
Tractor Rental	162
Salaries	50
Crop Insurance	10
Family Expenses	350
Total Cost	TD 729^{1/}

Value of Production Sold (Dinars)

Wheat	TD 150
Barley	300
Horsebeans	100
Chick-peas	100
Total	TD 650
Calves Sold	300
Wool Sold	25
Total	TD 973
Less Costs	729
Net Profit	TD 246

^{1/} The cost of TD 729 includes the cost of repaying the loan.

Source: Records of Office of Assistance to Small and Medium Agriculturists of Northeast Tunisia, and information provided by David Dupras, USAID/Tunis, Credit Advisor.

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Table D-31

COMPARISON OF ADDED PRODUCTION AND FARM VALUE OF CEREALS
(1971-1981 OVER 1960-1970)

<u>Cereal Crop</u>	<u>Added Production (1,000 mt)</u>	<u>Value*</u> <u>1981 Prices</u>	
		<u>(1,000 Dinars)</u>	<u>(1,000 U.S. \$)</u>
Durum Wheat	+ 3,290	TD 315,840	\$567,955
Bread Wheat	<u>847</u>	<u>73,689</u>	<u>132,510</u>
Total Wheat	4,137	389,529	\$700,465
Barley	<u>1,165</u>	<u>80,385</u>	<u>144,551</u>
Total Cereals	5,302	TD 469,914	\$845,016

*1 TD = .5561 U.S. dollar (1982 exchange rate).

Table D-32

Foodgrain Gap (Wheat and Barley) 1976-1985
(In absence of fertilizer program/average weather)

(1,000 mt)

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
<u>Production</u>	1149	669	944	989	1208	1250	1000	1000	1000	1000
<u>Wheat</u>										
<u>Consumption</u>	1070	1115	1160	1210	1250	1325	1391	1460	1533	1610
<u>5% per year</u>				<u>SOFT</u>	450	485	509	534	561	589
				<u>HARD</u>	800	840	882	926	972	1021
<u>Barley</u>										
<u>Consumption</u>	160	176	180	200	266	279	293	308	323	339
<u>5% per year</u>										
<u>Seeds</u>	170	170	170	170	170	170	170	170	170	170
<u>Stock Building</u>	150	150	150	150	150	100	-0-	-0-	-0-	-0-
<u>Corn</u>	1/	1/	1/	1/	1/	195	215	237	261	274
<u>Total Demand</u>	1550	1611	1660	1730	1836	2069	2069	2175	2287	2393
<u>Gap</u>	301	942	716	741	628	819	1069	1175	1287	1393

Note: 1/ Excludes corn.

Source: Newburg, Richard, Multiyear Proposal, Program Paper, Tunisia, PL 480, Title I, USAID - Tunisia,
March 1981, Tunisia.

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TABLE D-33

Some Relevant Social Indicators for 1959-1966

<u>Population Indicators</u>	1959	1966
Total population	3,783,169	4,533,351
Annual population growth	2.6%	2.5%
Urban population	29%	39.9%
Rural population	71%	60.1%
Population under 20 years	50.7%	45.3%
Adult literacy (15 yrs. and over)	16.0%	32.1%
<u>Income Distribution</u>		
Lowest 20% income group	4% of incomes	6%
Top 20% income group	64% of incomes	46.2%
Top 5% income group	--	18.0%
Rural population in absolute poverty	45%	20%
Urban population in absolute poverty	22%	27%
Total population in absolute poverty	45%	22.7%
Total population at poverty threshold	75%	54%
<u>Agricultural Indicators</u>		
Percentage of population active in agriculture	c. 73%	54.3%
Extension worker per no. of hectares	1: 19,500	—
Agricultural Eng. per no. of hectares	1: 54,800	—
Distribution of land*: 0-4.9% hectares		41% of farmers (6.7% of total land area)
50-99.9% hectares		2.5% of farmers (12% of total land area)
500 hectares +:		0.1% of farmers (6% of total land area)
1962: 100 hectares +:		
1.4% of farmers		
(i.e 22.1% of land)		
Percentage of Agriculture Produce in GDP	c. 29%	c. 20%
<u>Employment</u>		
Agricultural workers total	---	424,852
Male	---	416,839
Female	---	8,013
Female employment in total labor force	c. 6%	23.6%
Rural unemployment	---	108,000
Urban unemployment	---	59,000
Total unemployment	c. 15%	c. 15%
Rural underemployment	---	40%
15-19 yrs. old in labor force	---	10%
15-19 yrs. old unemployed	---	25%

(continued)

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TABLE D-33 (continued)

Some Relevant Social Indicators for 1959-1966

<u>Population Indicators</u>	<u>1959</u>	<u>1966</u>
<u>Emigration</u>	8,800 persons (1962)	12,600 persons
<u>Health and Nutritional Indicators</u>		
Life expectancy	40.7 yrs.	53 yrs.
Gross death rate per 1,000	20.0	15.3
Infant mortality per 1,000	202.0	125.0
Gross birth rate per 1,000	46.0	43.8
Caloric intake per cap./day -		
Average	---	2,340
Rural	---	2,250
Urban	---	2,600
Population below 2,000 cal./day	---	25%
Rural	---	30%
Urban	---	12%
Cereals consumption per cap./yr.	---	145 Kg. (1968)
Cereals expenditures per cap./yr. of house budget	---	32.8%
Cereals % of total caloric intake	---	56%
Durum wheat per cap. consumption/yr.	---	89 Kg.
Bread wheat per cap. consumption/yr.	---	44 Kg.

* In 1959, over 7 thousand ha, mostly in Northern region, were owned by foreigners, mainly French. No figures existed then on land distribution.

Sources: GOT Census 1956 and 1966; Annuaire des Statistiques; IERD, 1974 and 1980; Wersch et al; Perspectives Decennale du Developpement; Binnendijk; Hyslop and Dahl; Dalrymple; General Research.

Table D-34: Daily Caloric Intake According to Income Levels - 1975
(per capita, per annum)

Income Level— (TD)	Large Cities	Urban	Rural	Average
0 - 30	1226	1545	2058	2004
30 to - 60	1627	1975	2324	2231
60 to - 80	2082	2162	2606	2463
80 to - 100	2111	2401	2612	2434
100 to - 120	2178	2420	2754	2525
120 to - 160	2531	2513	2896	2686
160 to 200	2526	2599	3041	2730
200 to 300	2526	2804	3285	2799
300 to 400	2867	3147	3230	3017
400 and over	2811	3165	3351	2960
Average	2416	2432	2652	2543

Source: Consumption Survey, 1975.

TABLE D-35

Relevant Social Indicators for 1975-1980

<u>Population</u>	<u>1975</u>	<u>1979-1980</u>
Total	5,588,209	6,363,000 (projected for yr. 2000: 9 million)
urban (percentage)	2,779,180 (49.83%)	
rural	2,798,070 (50.17%)	
Annual population growth	2.32%	2.1%
urban	4.3%	--
rural	0.9%	--
Population between		
0-14 yrs old	47.3%	--
15-65 yrs old	52.7%	--
or		
0-19 yrs. old	53.2%	--
20-65 yrs. old	46.8%	--
<u>Income Distribution</u>		
Lowest 20% income group	5.0% of incomes	--
Top 20% income group	50.0% of incomes	--
Top 5% income group	22.0% of incomes	--
Total population in absolute poverty	17.0%	--
urban	20.0%	--
rural	15.0%	--
Total population at poverty threshold	37.0%	--
<u>Agricultural Indicators</u>		
Growth of agriculture in GDP	5.1% (1970-79)	--
Growth of agricultural production	-8.0 (1976-79)	-3.3%
Agricultural labor in total labor force	38.0%	35.0% (minus 41% in relation to total agr. labor)
Females	13.6%	--
Average age in labor force	50.8 yrs. old	(c. 55 yrs. old)
<u>Distribution of Land</u>		
0-4.9 hectares	40.9% of farmers (5.6% of arable land)	--
50-99.9 hectares	2.7% of farmers (12.04% of arable land)	--
500 and more hectares	0.4% of farmers (16.5% of arable land)	--

(continued)

TABLE D-35 (continued)

Relevant Social Indicators for 1975-1980

<u>Population</u>	<u>1975</u>	<u>1979-1980</u>
No. of ag. engineers in cereals production	11 Tunisians; 8 foreigners (entire country-all agriculture)	6 (1982)
No. of extension workers in cereals production	270 (High School level or lower - country - all agriculture)	
<u>Social Indicators</u>		
Unemployment	15.7%	--
Effective unemployment	30.0%	--
Emigration (persons/yr)	c. 15,500	--
Literacy	55%	--
Caloric intake per person/yr.	2,543	2,347
rural	2,542 ^{1/}	--
urban	2,416	--
16% of population with daily p.c. calories	2,045	50% of households of less than 50 dinars income have 57.5% caloric deficiencies
Food expenditures in total household (per cap./yr.)		
rural	48.8%	--
small urban	41.0%	--
urban	37.0%	--
Cereals in food expenditure (per cap./yr.)		
rural	24.4%	--
small urban	21.7%	--
urban	17.1%	--
Cereals consumption per cap./yr.		
average	181.29 Kg.	--
rural	203.57 Kg.	--
urban	163.66 Kg.	--
<u>Health Indicators</u>		
Crude birth rate per 1,000	35.4 (1977)	31
Crude death rate per 1,000	12 (1977)	11
Total fertility rate	4.6% (1977)	4.4%
Life expectancy	57 yrs. old (1977)	58 yrs old (48 in 1960)

^{1/} Rural here includes small urban agglomerations and dispersed rural centers.

Sources: IBRD 1974, 1980, 1981; FAO 1979, 1980; Consumption Survey 1975; Perisse and Kamoun: Johnson; Office des Cereales interview April 1982.

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APPENDIX E

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Mr. Pat Demagoe
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Technical Services Division

Madame F. Larbi
Head, Extension Service for Barley
Technical Service Division

Mr. Zahrat Mediene
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Beja Service Area

Mr. Mongi Milika
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Mr. Mouldi El Ghanmi
Director
Seed Control Service and Laboratory

Private Tunisian Farmers

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Mr. Ali Ben Hamed Mounie
Mr. Mabroul Ben Chedly
Mr. Khelifa Ben Mhawar
Mr. Addel Krim B. Mohammed

Pont du Fahs Area

Mr. Mustafa Buheni
Mr. S. Abdeuahman Bouliam

Jenedouba Area

Other Farms Visited

Sbiba - " " " " " " " " " " " " " " " " " "

Siliana - On-farm herbicide test demonstration, and wheat variety trials

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[MIAC])

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(Faculty members attending wheat seminar at INAT in Tunisia)

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Dr. D. Brewer

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(formerly with Ford Foundation on Cereals Improvement Program
in Tunisia)

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Agricultural Economist

APPENDIX F
PHOTOS



Wheat, a staple food of Tunisia, is ideally suited for growing in the Mediterranean climate in the

Medjeda Valley in the north where much of the country's wheat is grown.



Wheat was an important crop in Tunisia during the Roman occupation (around 300 B.C. to 200 A.D.). Roman ruins in some fields are evidence of a highly developed civilization and technology, such as this aquaduct which brought water from the mountains near Pont du Fahs to Carthage, 50 miles away.



Mustafa Buheni, 2nd from right, a farmer in Zaghouan Governorate, discusses production results on his 5 hectare farm with extension agent. This was his first year in using the high-yielding wheat varieties. While production was greater, weed problems increased. Team members Mona Fikry, right, and Carl Ferguson, left, take notes.



This field illustrated the weed problem in Tunisia. William Fred Johnson, team leader, and Tunisian extension agents inspect this field contaminated with poppies. Herbicides

can eradicate such problems, but shortage of supplies was a problem in 1982.



Farmers have learned to use herbicides for weed control. Hand sprayers have been introduced for use of farm family members, including youth.



Raising of livestock, both sheep and cattle, is being integrated with production of cereals, rotated with forage crops, as feed, and grain

legumes for human consumption and livestock feed in Tunisia.

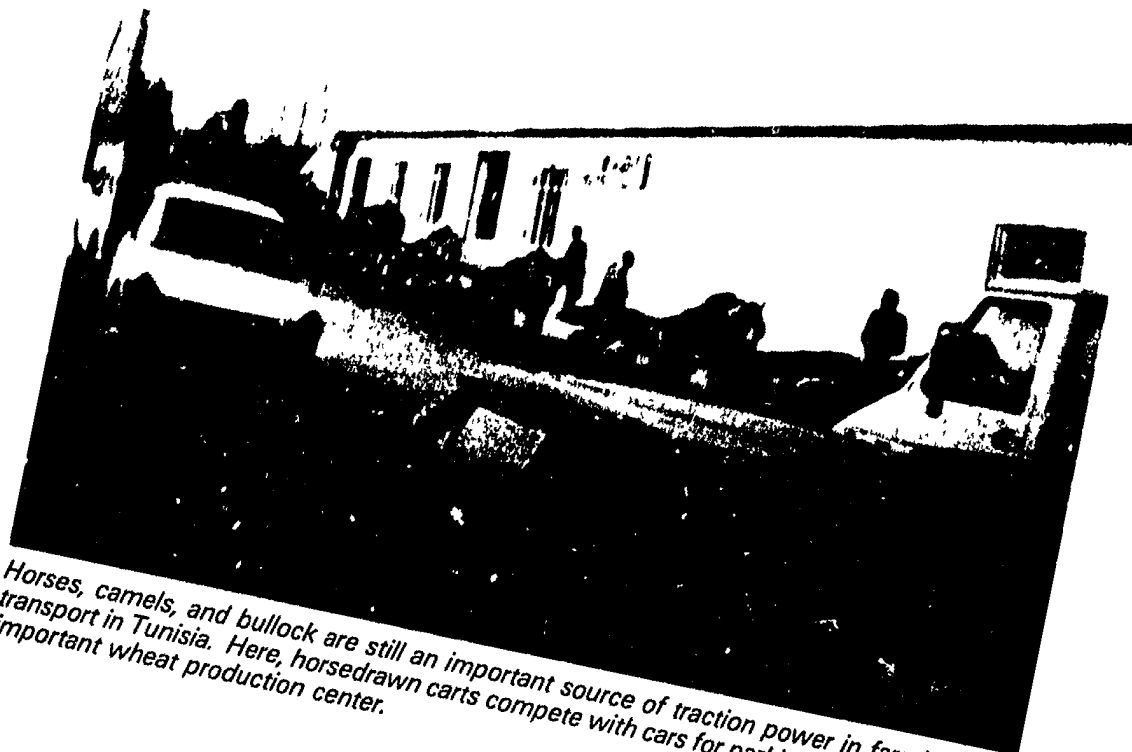


Cattle raising for milk and meat production is emphasized by the Government of Tunisia in the

integration of livestock with cereal production in rotation with forages and grain legumes.



Sala Ben Hesoun Netzi, center facing camera, seeks credit from APMANE agent for purchasing an imported breed to improve his herd of cattle on his 30 hectare wheat-forage production farm in Beja Province.



Horses, camels, and bullock are still an important source of traction power in farming and transport in Tunisia. Here, horsedrawn carts compete with cars for parking space in Beja, an important wheat production center.



Storage space for wheat and fertilizers is a problem during peak seasons when outside pallets and canvas tarps are sometimes put to use. William Fred Johnson, team leader, inspects outside facilities in Beja Province.

APPENDIX G

OFFICE DES CEREALES - DIVISION TECHNIQUE -			
COMMUNIQUE			
<p>Dans le cadre de la promotion de la céréaliculture, de la Division Technique de l'Office des Céréales organise des journées d'information portant sur</p> <ul style="list-style-type: none"> - L'Utilisation des variétés de blé à haut rendement - L'introduction de la luzerne annuelle dans l'assolement - L'Emploi des Engrais et des herbicides - Les Techniques culturales des légumineuses à graines conformément au programme suivant : 			
DATE	REGION	HEURE	LIEU DU RENDEZ-VOUS
Mercredi 21 Avril 1982	Kairouan	9h30	Délégation de Oueslatia
Mardi 27 Avril 1982	Medjez	8h30	Service Agricole Medjez
Mercredi 28 Avril 1982	Zaghuan	8h30	C.R.D.A. de Zaghuan
Jeudi 29 Avril 1982	Mateur	8h30	Service Agricole
Vendredi 30 Avril 1982	Bizerte	8h30	C.R.D.A. de Bizerte
Mardi 4 Mai 1982	Bou Arada	8h30	Service Agricole Bou Arada
Mercredi 5 Mai 1982	Tunis	8h30	Délégation de Mornaghia
Jeudi 6 Mai 1982	Cap-Bon	9h00	Service Agricole Korba
Mardi 11 Mai 1982	Jendouba - Bou Salem	9h00	C.R.D.A. de Jendouba
Mercredi 12 Mai 1982	Téboursouk	9h00	Service Agricole Tébourouk
Jeudi 13 Mai 1982	Béja	9h00	C.R.D.A. Béja
Mardi 18 Mai 1982	Siliana	9h00	C.R.D.A. Siliana
Jeudi 20 Mai 1982	Tadjerouine	9h30	Centre de l'Office des Céréales
Mardi 24 Mai 1982	Le Kef	9h00	C.R.D.A. du Kef
Jeudi 27 Mai 1982	Dahmani	9h00	Service Agricole Dahmani
Ce communiqué tient lieu de convocation personnelle pour tous les techniciens et céréaliculteurs.			

Above is a Notice which appeared in La Press, a national Newspaper, on three consecutive days during the week of April 19, 1982 concerning farmer field days to be held in different regions during the months of April and May. The subjects of the field days were:

- The utilization of high-yielding varieties of wheat
- The introduction of annual legumes into the rotation
- The use of fertilizer and herbicides
- Cultural practices for grain legumes

APPENDIX H
NOTES ON AUTHORS

William Frederick Johnson, Agricultural Economist with AID since 1961, is currently with the BIFAD Staff, having transferred from the Title XII Coordination Staff in the former Technical Assistance Bureau, AID/Washington, where he had served since returning from Vietnam in 1975. Other AID posts and special assignments have included Liberia, Tunisia, and several other countries in Africa, and Indonesia, the Philippines, and Vietnam, and the former East East Bureau in Washington. Positions held include Agricultural Economic Advisor to host Governments and AID Food and Agricultural Officer. He served with FAO on its staff in Rome, Italy, and in Saudi Arabia as Chief of FAO Mission and as Agricultural Economic Advisor. Other Government experience include the Office of Price Stabilization as Price Economist and Economic Analyst with the Department of Defense in Japan. In the private sector, he held the position of Director of Research and Development, and of Natural Resources Economist with a private company. He attended the University of Tennessee and holds a B.S. degree in Geological Engineering from the University of Oklahoma, and a Masters degree from Harvard University where he majored in Agricultural and Developmental Economics under the late Professor John D. Black and Professor John Kenneth Galbraith. He is fluent in the French language, and also speaks Italian, Japanese, and German in this order of fluency.

Carl Ferguson, Agronomist, is currently a Consultant for AID. He retired from AID in 1978 following assignments in Paris (Marshall Plan), Iraq, Haiti, Senegal, Morocco, Tunisia and Washington, D.C. He served as Food and Agriculture Officer in Senegal, Morocco, and Tunisia, and in AID/Washington as the Deputy Director, Office of Title XII Coordinator and University Relations. He holds a degree in Soil Science from the University of Missouri, and taught Soil Science and General Agronomy at Texas A & M from 1946-51. From 1951-54 he served in the Soil Conservation Service at Beltsville, Maryland. He is fluent in the French language.

Mona Fikry, Development Anthropologist, is currently a Consultant with USAID. She holds a Ph.D. degree from Indiana University and has taught in the U.S. and Algeria. She has been involved in projects and research in North Africa, the Middle East, Central Africa and the Sahel. Her most recent tour was two years in Mauritania working on the Rural Sector of the Four-Year Development Plan of Mauritania. She is fluent in the French and Arabic languages.

BIBLIOGRAPHY

I. AID SOURCES

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Dalrymple, David, Economic Aspects of Nutrition Improvement in Tunisia, Foreign Economic Development Service, USDA/USAID, Washington, D.C., 1970

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